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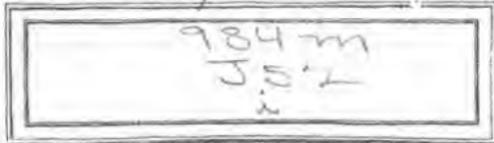
INTERESTING NEIGHBORS

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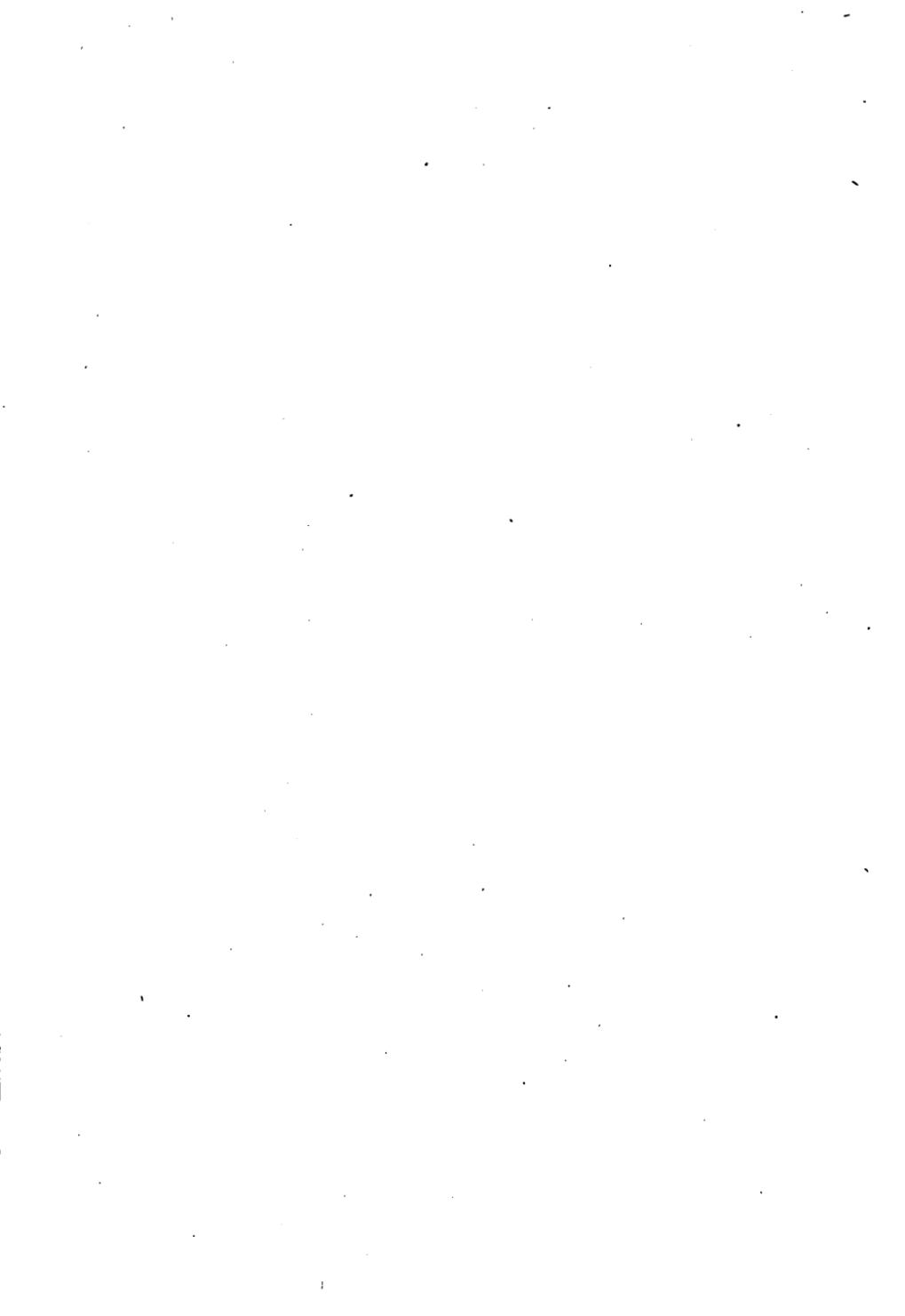
Class of 1900





INTERESTING NEIGHBORS

JENKINS



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**INTERESTING
NEIGHBORS**

BY

OLIVER P. JENKINS

Emeritus Professor of Physiology, Stanford University, California

*81 ILLUSTRATIONS BY
W. S. ATKINSON*

PHILADELPHIA
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PREFACE

The stories that follow in this little book began with some that were prepared for a small group of children in whom the author was affectionately interested. The reason for the stories being written is that some members of this group resided elsewhere. Through these children the stories became known to a larger circle and there arose a desire on the part of the new acquaintances (among them some teachers) to have them compiled and published.

Despite the efforts of those who have great faith in the educational value of a knowledge of nature, there still remains much to be accomplished. Consequently, no one need apologize for an honest attempt, no matter how humble, to bring young children in contact with the wholesome intellectual stimulus and satisfying knowledge that comes from an acquaintance with the wonders of out of door life.

One might well ask what principle should guide one in making a selection, from the great wealth of material that is available, when but a very few subjects can be presented in this form. The confession must be made, that no great principle has been conscious in the author's mind in the selection of subjects, unless that of taking up what is near

at hand, or more or less easily available and easily understood, may be called a principle. Many other selections equally as good as those that follow might have been made.

As may readily be seen, no attempt has been made to introduce what might be called the technical science of the objects treated. That valuable knowledge of nature can come to better advantage when the children are older and it will then be entered into with greater intelligence and zest by them if they have had already a happy experience and familiarity with the objects and phenomena all about them.

It was thought best to use enough detail to make a clear picture of some phase of the life of an object, and this has been attempted with the milkweed butterfly. If, in the opinion of some, this has been carried too far, the explanation is, that by giving a fuller account of the life of at least one of the butterflies the children would have a guide to the deeper study of these attractive creatures. The one chosen is widely distributed and the teacher can find excellent accounts of its life in many books.

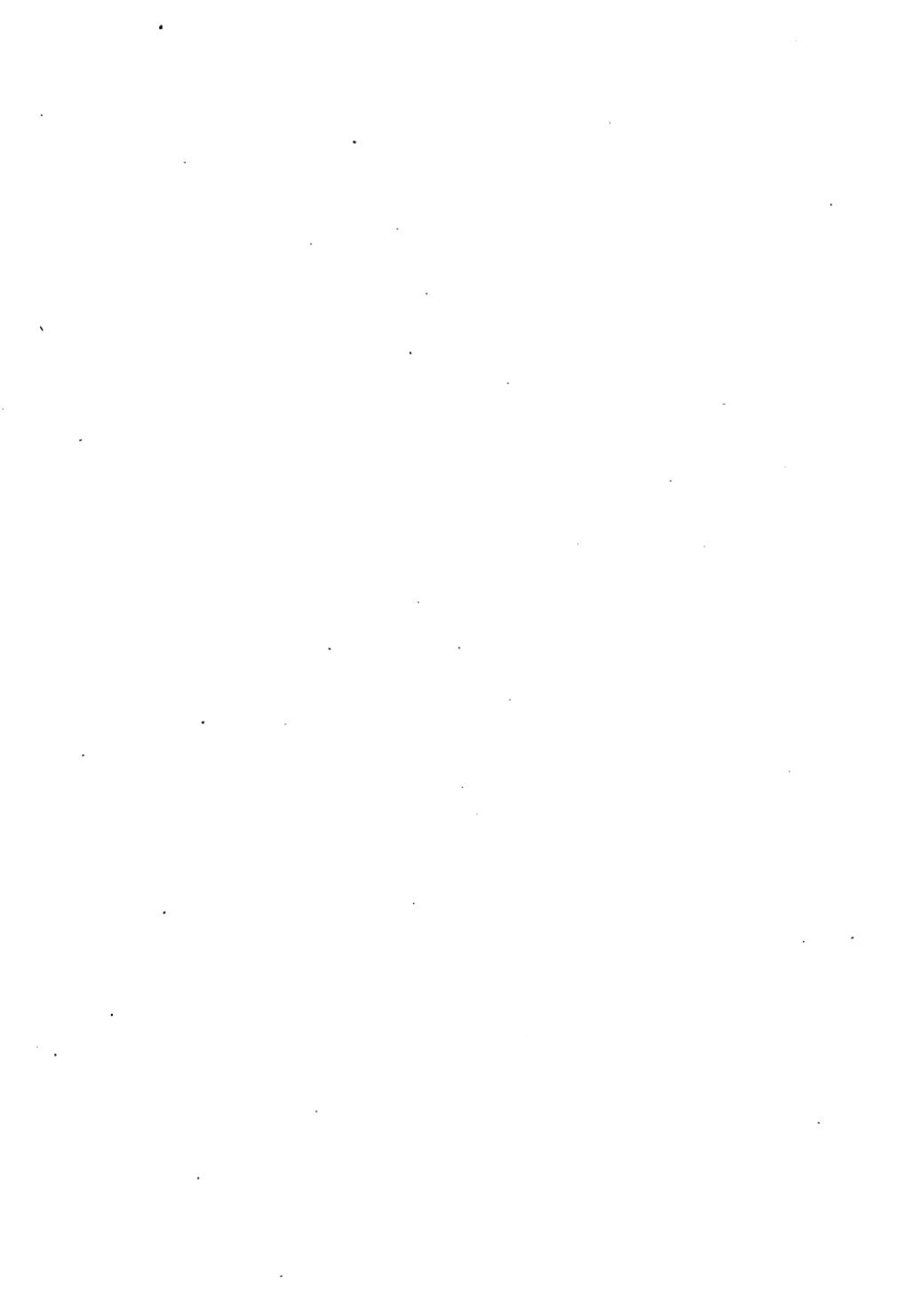
While this and the other little books to follow are termed readers, the author perhaps need not insist that the value of each lesson is greatly enhanced by having before the pupils when possible the real object read about. It will be noted that the majority of the objects can be found in most parts of our country.

A list of reference books has not been given, for the reason that at the present time there is such a large number of excellent works on entomology, zoology, botany and nature study, that any teacher who wisely wishes to be informed in regard to these and similar subjects can readily get the titles. This might be said to be a matter of common knowledge.

The drawings are the work of Mr. W. S. Atkinson to whom acknowledgment is here made for his interest in the work and the excellence of the illustrations.

OLIVER P. JENKINS.

Stanford University,

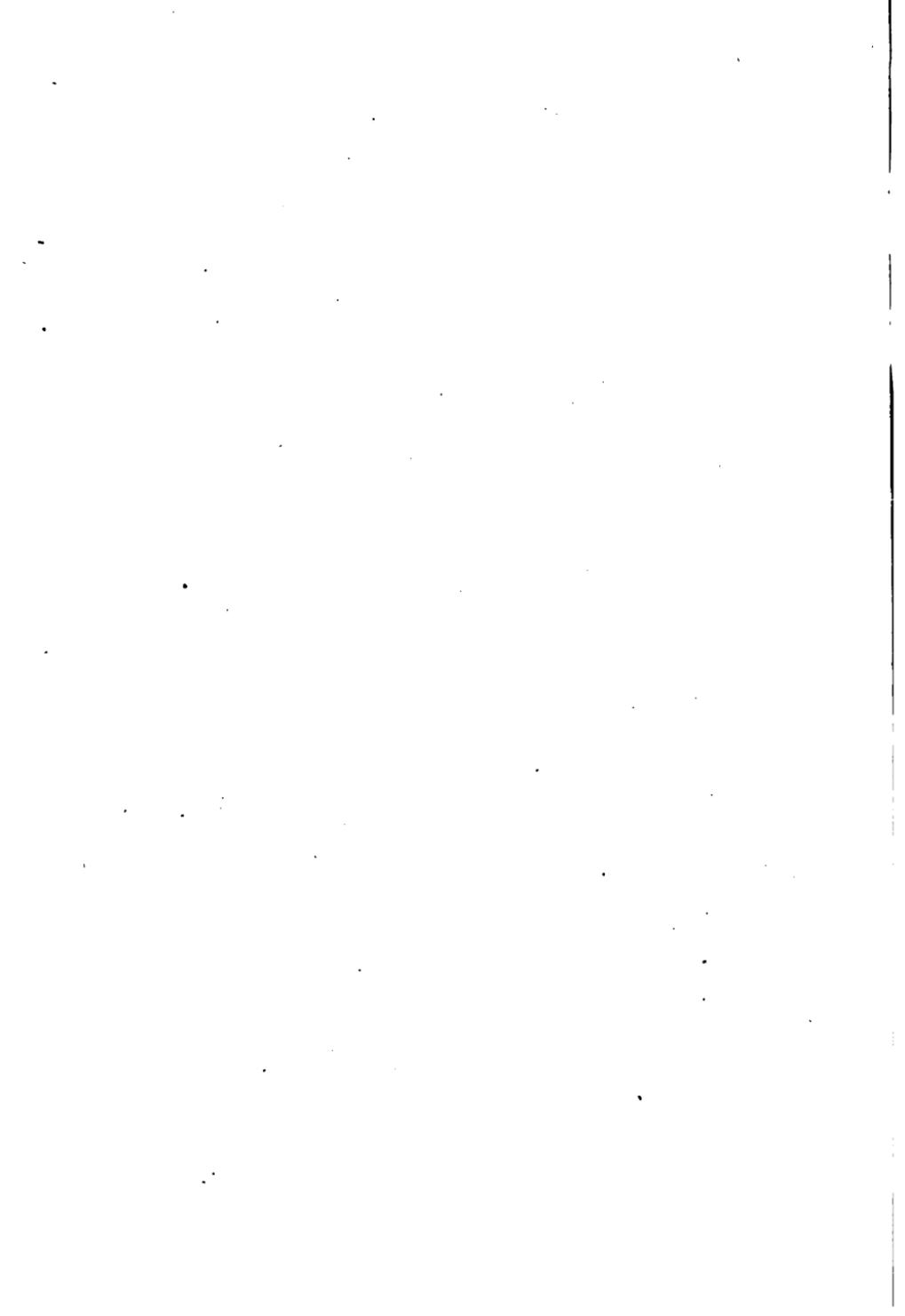


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THE MAGIC HOUSE

Sometimes people have a hard time getting a house to live in. They search all over town only to find that the houses are occupied by somebody else, so they have to build one for themselves. They get boards, bricks, nails, mortar, stones, iron, pipes, wires and many other things together. Then they have to get men with hammers and saws, spades and trowels who hammer and pound and saw and dig, and work hard for many weeks to build the house. And then they must find painters to paint it and finish it up to look nice. That is a lot of trouble and bother.

But there is one little animal that can build her house by what looks just like magic. This is the little gall-fly. There are many kinds of gall-flies which can do this, but this story is about one that builds her house on the White Oak tree.

She lays eggs, from which the baby gall-flies are hatched, and this is the way she goes about it.

She alights on the White Oak in the spring time and searches over the branches until she finds a new bud that is just about to grow into a new branch. She lays her eggs in the bud, and gives them some kind of charm so that just when the babies hatch out and begin to grow, they use

the charm on the bud. This then, instead of growing into a twig or branch, grows like magic into a ball-shaped house which covers over the gall-fly babies. So down deep in this new house, in tiny round rooms, the gall-fly babies live and feed and grow. At first the gall-fly babies are little white things called grubs or larvae. Their ball-shaped house we call an oak-gall. The food of the babies is the juice of the oak tree which is called sap and which comes from the twig of the oak tree into the oak-gall and seeps to them through the walls of their tiny rooms. Thus you see that they not only find the house all furnished for them, but also that their food is brought right to their rooms. The oak sap is the same to them as milk is to human babies.

The outside of the gall is hard and smooth and keeps most of the bad things away from the little fellows. Each little grub eats the food that comes to it, and gets fat. Its little white fat body would be fine food for other little animals if they could get at it.

Now there is the little lizard which hunts around for just such food. To the gall-fly baby he is a real hobgoblin. I think he is the one the gall-fly mother means when she says: "The goblins will get you if you don't watch out." But when the lizard comes up to the gall house he finds it so hard and smooth that he cannot bite into it or do a thing to it, so the goblin has to go away and get his dinner somewhere else.

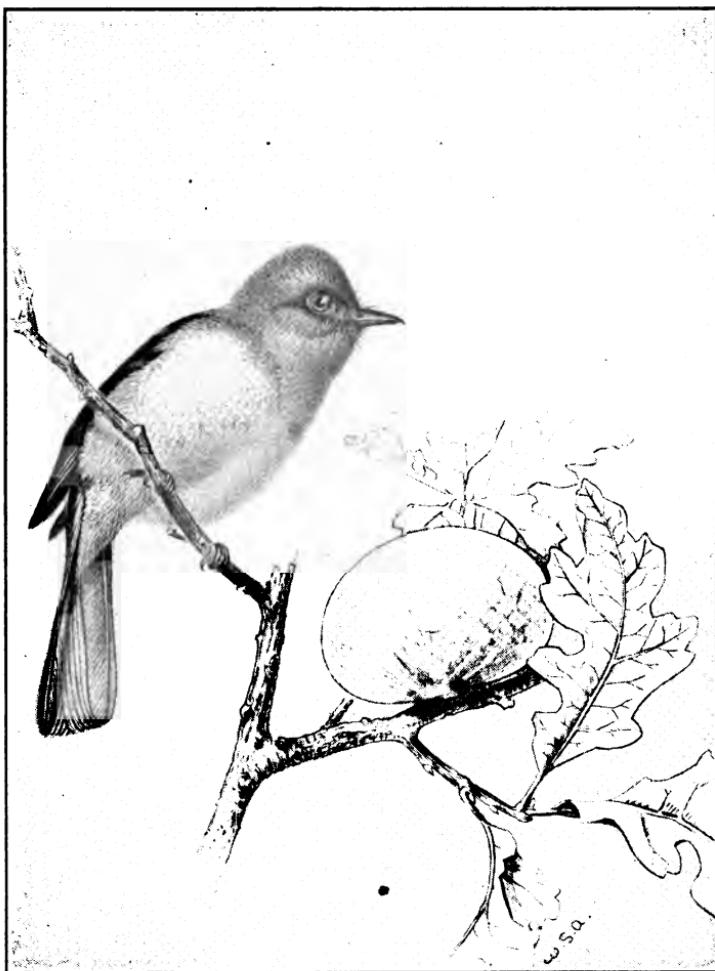


FIG. 1.—The bird (a crested flycatcher) cannot harm the grub of the gall-fly secure in its house.

And there are the birds. Now the birds that alight on the oak tree are very nice looking animals. They dress in fine feathers and keep themselves neat and clean. Some twitter very sweetly; others sing beautifully and no doubt all of them think themselves very lovely, but let me tell you that some of them hunt up and down the limbs of the trees for little insects and their babies, and whenever they catch them, gobble them right down, just like you would a chocolate drop or a marshmallow. They think a nice white grub is about the tastiest thing there is. But when a bird comes to a gall house, no matter how badly he wants the gall-fly baby, he can't touch it. The gall house is too hard for him to pick into and he might as well try to scratch into a rock as to scratch the gall-fly out of it. While this spry little bird thinks he is pretty smart, he is not smart enough to get ahead of the gall-fly. I suppose that if the gall-fly told her children any stories, she would call the bird a big ogre.

Then there is another animal that must look to the little gall-fly like a terrible griffin. It is the tree-frog. She sneaks around the leaves and bark of the tree ready to snap up with her big mouth any poor insect that is not on the look-out. But when the tree-frog hops and crawls about amongst the branches and leaves and comes upon the gall house, she crawls all over it but can't find a window or a chimney to sneak in. She stares at it with her big eyes as much as to say, "What do you

think of that?" But she has to pass on and make her supper on insects which have no houses.

When there comes a heavy rain storm which soaks the trees and ground and everything through and through the water runs right off the gall house and does not touch the gall babies. There they lie tucked up nice and dry and as snug as a bug in a rug, or snugger.

And when the wind blows, it only swings the house up and down and does not hurt anything. No doubt the gall-fly mother could have been the first to sing: "Rock a bye baby in the tree top, When the wind blows, the cradle will rock." The gall-fly baby's cradle grows so tightly to the tree branch that it does not fall except, of course, when the bough breaks.

Now do you not think that the gall-fly people are like fairies, since the tiny gall-fly baby, when it is first hatched out of the very tiny egg, can, by touching the leaf bud with something, make it grow up to be what, to it, is a very large and well furnished house with just the right kind of food for it?

While the gall-fly egg and later the baby is well cared for by the house and food, prepared as if by magic, still it has trouble sometimes. There are some other insects which are bad to it if they get a chance. As they have no home of their own, they manage to pierce a small hole in the gall while it is tender and still very small, and lay their eggs in it too. When these eggs are hatched, these robber

grubs steal the gall baby's food and, sad to say, some times eat the gall baby too. But they do not always get the gall children.

When the gall-fly babies, called larvæ, eat enough and grow big enough, they change into the form of the mother gall-fly and have wings. They have good strong mouths and gnaw their way out of

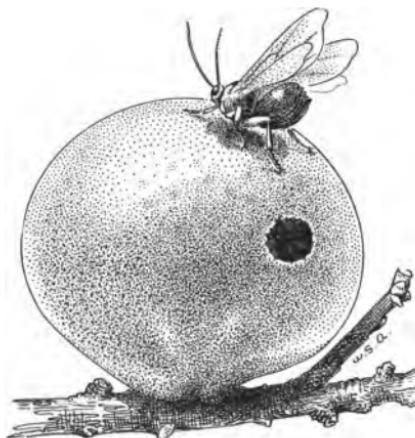


FIG. 2.—The giant oak ball. The gall-fly has just come out of its home

the house and come out of the little round holes you can see in the picture of a gall (Fig. 2). They then fly away and lay eggs on other oak buds, and these will grow up into other gall houses. There are many kinds of gall-flies and each makes its own kind of gall. The kind I have been telling you about is the largest kind and for that reason is called the giant oak-gall. Sometimes they are called oak apples because they look like apples.

Gall-flies make galls on other sorts of trees and plants and sometimes they make them on the leaves or on the roots instead of on the twigs or branches.

If you wish to gather galls and watch the gall-flies come out, the best time is, of course, in the spring and summer when the gall-flies are laying their eggs and the galls are growing. They grow through the summer, but most of them come out in the fall.

Of course if you wish to obtain live gall-flies the galls should be taken only when they are about fully grown. Otherwise the food sap would be stopped and the gall babies could not finish their growing. You can cut open some of the dry galls and see where the little grubs lived and when you get fresh galls you can cut them open and find the live grubs.

There are a few other insects which make galls but most of the galls are made by gall-flies.

A very good way to catch the gall-flies as they come out is to put the galls into a paper box with a good lid. A shoe box or a candy box will do. In one end of the box make a small hole into which the neck of a small bottle is tightly fitted, leaving the wide part of the bottle out of the box. After a while, the new gall-flies gnaw their way out of their dark home and get into the box instead of the open sunshine, so they hurry to the place where the light gets in, which is the neck of the bottle, and crawl into it and then you see them in the

bottle. A test tube can be used instead of a bottle.

Another good way to catch them is to put the galls into a glass jar and tie over its mouth a piece of fine netting or cloth that will let air in but will not let the gall-flies get out.

Of course the box and bottle, or glass jar, can be used for other insect eggs and also for cocoons.

THE LEAF-CUTTER BEE

In the garden there grows a lilac bush which everybody loves for the beautiful sweet smelling flowers it gives us early in the spring. One day after the lilac flowers were all gone, we were looking at the plant, when some of the leaves looked a



FIG. 3.—A lilac leaf with pieces cut out by a leaf-cutter bee.

little strange. They had pieces taken out of them, just as if some one had done it with small sharp scissors. That was quite a puzzle, for why should anyone wish to do that?

By watching the bush day by day the mystery was solved. A little insect, which looked some-

thing like a bee, came to the bush. She alighted on a leaf and began cutting out a round piece of the leaf with her jaws. She worked quickly and soon had the piece out and then flew away with it, holding it tightly with her two hindmost legs. After a time, back she flew and began to cut out another piece. This time the piece was a little longer with rounded ends. When she flew away with it, she looked funny with this bit of leaf waving in the air like a tiny flag.



FIG. 4.—The leaf-cutter bee.

What was she up to? That was the next puzzle. Well, quite a way off she came to a small hole in the ground. She alighted near it and ran

to its mouth and disappeared down the hole with the piece of leaf. Soon she was out again and off for another piece. She went back and forth from the lilac bush many times for pieces of leaves.

In the hole was her nest in which she would lay her eggs. From these would be hatched the white grubs which would, in time, turn into bees like their mother.

People who have spent much time watching these bees have found many nests and have taken them apart to see how they were made. The bee first digs a hole in the ground a few inches deep. Or she may clean out a place in some rotting post or tree, or she may even use a crack between two boards that just suits her.

After getting the place all ready she seeks for the kind of leaves that suit her. Our bee used lilac leaves, but this kind of bee very often uses rose leaves.

Then she begins to cut out the pieces of leaves. Because she does this she is called the leaf-cutter bee. She has sharp strong jaws which work like a pair of scissors. She alights on the edge of a leaf and very quickly cuts out either a round or oblong shaped piece. It is cut very neatly and true. She takes hold of the piece with her two hindmost legs and flies away to her nest. The round piece she presses down with her head to the bottom of the nest. The oblong piece she uses to line the sides of the nest.

Then she visits some flowers and gathers a little honey and the dust, called pollen, that comes off the stamens, and mixes them together into a sort of sweet cake. She puts this in the nest and then lays an egg on it. Then she flies to the bush again, this time for a round piece of leaf. She pushes this down to cover over the sweet cake and egg. Now she has provided for one egg.

On top of the lid of this first room of the nest, she builds another with pieces of leaves, just like the first. She gathers honey and pollen and



FIG. 5.—Nest of the
leaf-cutter bee.

makes another sweet cake, lays another egg and puts a round leaf top on and she has number two done, so that she has now cared for two of her children.

She works away in this manner until she has the hole she made in the ground filled with little nests one on top of the other. Each one with an egg and a sweet cake in it.

Then she may make other holes in the ground and fill them in the same way, for she is a very busy bee and works fast and hard.

In making up these nests she sometimes uses hundreds of pieces of leaves and must visit hundreds of flowers for honey and pollen. One man took apart the nests of one bee and counted one thousand pieces of leaves which she had cut out and carried to her nest. No one knows how many flowers she had to visit to get the things with which to make sweet cakes for her babies.

The eggs in these snug little nests lie still quite a while and then tiny white grubs are hatched, just like the grubs of all other kinds of bees. Each little grub soon finds the sweet cake its mother made and begins to eat away on it. As this is fine and nourishing, it grows well on it, and needs no other food. In time it gets to be about as big as its mother but does not look like her yet. It looks like a short fat white worm. Then it stops eating and spins a thin silk cocoon about itself and lies still as if asleep. But like most insects while in the cocoon it changes to another

strange form called a pupa. Then after some time, the pupa changes into a leaf-cutter bee. Each of these new bees has strong jaws and is able to gnaw its way out of the nest. Soon then, there comes out of the rows of nests a little group of leaf-cutter bees ready for work. Then those amongst them that are to be mother bees fly forth in different directions to find good places to start the work which we found the first mother doing, that of making nests and cutting leaves, gathering honey and pollen and laying eggs for new families of leaf-cutter bees, just as they have been doing for thousands of years.

While mother bees are so hard-working and take such good care of their eggs and children we shall always have the interesting leaf-cutter bees with us.

You may not be able to find any nests of the leaf-cutter bee because they are hidden away very carefully. But you can often find rose leaves or lilac leaves neatly cut out, as in the picture. When you find a leaf like that you can press it and put it in your scrap book and pretend that the little leaf-cutter bee marked her name that way. Whenever you look at the leaf you can think of the careful busy little bee that cut it. We have pressed and kept our lilac leaves so as to remember our bee.

THE CARPENTER-BEE

We were walking about the garden, enjoying the sight and scents of the healthy growing plants. Soon we stopped before a bed of flowers. All over it were a number of busy insects. Brown and yellow honey-bees, bright colored wasps, and beetles, black, green and red, were flitting from flower to flower. Here and there a butterfly came to add more beautiful colors to the scene. Each of these strange little beings seemed to be getting something from the brilliant and fragrant bed of flowers that made them lively and happy.

Suddenly, a big black bee-like insect, as big as a bumble-bee, flew in with a rush. It hurriedly thrust its head into one flower after another and before we could see it fairly well, off it buzzed like a black streak.

Well now, what was that? It looked like a bumble-bee, but it certainly was not a bumble-bee. For that easy going old thing rolls along more slowly and takes more time to push its nose into the different cups of nectar which the flowers are holding up for it to sup. But this new one went racing along at such a rate that it must have just



FIG. 6.—The carpenter-bee.

gobbled up whatever it got from the flowers. Well, whenever anybody makes a great stir everybody else wishes to know right away what it is all about.

So we got curious to know who this little whirlwind was. We waited for the black buzzing streak to come back but it wouldn't do it. No doubt one who seemed to have so much business to attend to and could fly so fast had other flower-beds far away to visit.

So we appealed to a friend standing near, who knows much about insects, to help us out. She told us that that was the big carpenter-bee. A carpenter-bee? Well, we had seen and heard of mason-bees which make mortar and build houses with it; and tailor-bees which cut out pieces of leaves, like cloth, with which to line their nests; now here is a carpenter-bee. "Yes," said the friend who knows insects, "and there are miner-bees which bore holes in the ground like miners do." The miners dig for gold and silver but the miner-bees bore holes in the ground to make themselves nests to lay eggs in. If we will only take the trouble to find out, we will be astonished at the wonderful things the different kinds of bees and many other kinds of insects are doing right under our feet, over our heads, and all around us.

But just now we are concerned about this big carpenter-bee. It is called a carpenter-bee because it works in wood. It has a big head and very sharp, strong jaws. For its nest, it bores a hole

right into solid wood, large enough to put your finger in. It may pick out a fence post, a timber in the house or barn, or the trunk of a fallen tree. If the wood is of a hard kind, it has to work very slowly and with great labor. But it has great patience and great industry and works away day after day until it has made a hole several inches deep. The hole is straight for a little way and then makes a turn down the post or log. When done, it may be as much as a foot long. That is great work for so small an animal.

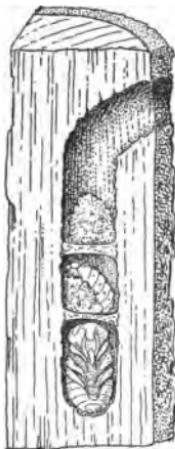


FIG. 7.—Nest of a carpenter-bee.

This hole is its house and nest and is ready for the egg laying. Now its work changes. Just like the leaf-cutter bee it plans to put a sweet cake of honey and pollen, made from the flowers, beside each egg that it lays. This is to be the food for the little worm-like grub that will hatch from the egg. The grub, you know, just the same as with other bees, at last becomes a bee.

It must be quite a rest from the hard jaw-aching work of gnawing wood to go out after honey and pollen among the flowers. This was what the big black buzzer was doing when we first saw her. She gives her jaws a rest and uses her tongue to suck up the nectar. Then she has a nice brush with which to gather the pollen. When she gathers enough of both to make a cake for one grub, she puts

it in the very bottom of her nest and lays an egg on it.

Next she takes some of the tiny chips she saved from the boring work and with some liquid from her mouth she glues them together and makes a thin but strong little roof across the hole above the cake and egg. The egg and cake are now safely shut up in a tiny room.

Off she goes for more pollen and nectar for another cake. This is placed just above the first room and another egg is laid with it. A roof or cover is built over them and she has a second room.

She works quickly at this until she has the hole she bored filled with little rooms one above the other, an egg and a cake in each. When the grub is hatched out of the egg, it finds the cake ready for it to feed upon.

The hard-working mother has done all she could to give her children a well-protected home and provide them with plenty of just the right kind of food for them to live on until they grow up to be as big as their mother.

I am sorry to say that some other insects, and birds too, know how delicious the sweet cakes are and how tasty the fat white grubs are. And they have learned ways of stealing them, although the mother bee takes care to place the eggs and sweet cakes deep down in a hard wood tunnel. The birds can't reach very far down the hole, because she made a turn in it as you, no doubt,

recall when she bored it out. But certain insects have a very evil way of acting against her. When she is off getting honey and pollen to make a cake for a room, these sneaking insects slip in and lay eggs with the egg she has laid. They know that their babes will hatch out along with the grub that comes from the bee egg.

This puts these enemies right there in its own little room all ready to eat up the poor bee grub as soon as it is fat enough. It must be frightful to wake up in your bed to find an ogre ready to eat you up, and your room shut up so tight that no one can come to help you.

But the invading insects do not always get into the nest of the mother bee and so the eggs may all hatch and soon the grubs grow to be bees. When they do, the one in the lowest room is ready first, then the one above and so on until the hole is full of new carpenter-bees eager to go to work as their mother did as soon as they get out.

This big carpenter-bee, with its noise and important ways, made us first take notice of carpenter-bees. We soon learned that there are many other kinds of carpenter-bees.

By careful watching, we saw a very pretty little blue-green bee very modestly hovering over the flowers and alighting on them. She was pretty shy and darted away at the least motion toward her.

She, too, has strong jaws, but being so small she does not attempt such tough jobs as does the big

carpenter-bee. She searches out stems of plants that have pith in the center. This is soft and easy to bore out. She makes a tunnel in the pith center of the stem and uses this as her home. She makes tiny rooms in this tunnel just as the big bee does in the hard wood and lays an egg in each, provided with a honey cake in the same way.

It is said that this little mother bee acts differently from other carpenter-bees, for when she has finished her work, she waits at the top of the tunnel for her children to come out.

Just as it was in the nest of the big carpenter-bee, so in this, the lowest one in the tunnel changes into a bee first, because the first egg was laid there. Because all the other nests are above it this first one must stay down there cooped up in its room, until the others are changed into bees.

This they do, one after the other, but all must lie quietly until the uppermost one is ready. This one then gnaws his way out with his new strong jaws, then the next one below him does likewise and so on until the lowest one is set free and the whole of the family comes forth.

Now the waiting little mother bee can be proud of her little flock of children in their new shining blue-green clothes. The children must be happy to get out into the bright sunshine and stretch their pretty wings for the first time. But for them life is to be full of work and they soon fly away to repeat the kind of busy life their pretty little mother lived. Were they not fortunate in

having her with them to start them off in life? One little girl friend of mine told me that she likes this bee best because it waited for her children instead of rushing off and leaving them to shift for themselves.

HOW THE TEACHER WAS TAUGHT

Once upon a time; many years ago in a little town in the far away country, France, there was a little school full of boys of all sizes. The boys were full of life and mischief, so that the teacher had all he could do to keep them down to their lessons. The teacher was a very young man and did his best to interest the children and do them some good.

One day in the week they had school out of doors. Teacher and pupils tramped off to a field to practice measuring land. This gave them a chance to learn about squares, triangles and polygons and to make up problems in arithmetic. The pupils thought it great fun, for there were many things to interest them besides what they came out for. And the teacher had all he could do to keep them down to their task.

Once when he was at one end of the measuring line, some of the boys who had the other end seemed to have dropped it and were busy with something else. Of course the teacher had to hurry down to look into the matter. He found that the boys had left the measuring line and stakes and were picking up, here and there, a stone, and were poking straws into it and sucking something through them. They were getting honey from a hard rock.

This time the pupils could teach the teacher something they knew very well and which he had never heard of. They gladly showed him a new trick and he gladly learned it from them. They now all joined in searching for stones containing honey. The teacher learned for the first time that



FIG. 8.—Mason bee and nests.

a large black bee made a little house of a sort of mortar. She built it on the side of a stone. In the rooms of this house she had placed the honey, of which the boys were robbing her.

Well, they had their play then went back to work and to school. But the teacher could not forget

the bee and its strange house. The pupils had taught him about the honey, but the teacher wished very much to learn more about the wonderful ways of a bee that could make mortar and build a house with it. So later he returned to the field to find out what he could. He did find out many curious things about the life of this strange bee. Then he tried to find books to help him. He was fortunate to learn of a fine book with beautiful pictures of many kinds of bees besides this one, by a noted student of bees and other insects.

This was the beginning of a life-long study of insects by a man who is known as one of the most famous of those who have found out a great number of the wonderful things that go on in the insect world, and has described them in many interesting books. This teacher was the noted French student and writer of insects, Dr. J. H. Fabre. I hope you will have the pleasure of reading some of his charming books.

The bee that started this fine student at work was one of the mason-bees. The home of this one is in France. But there are mason-bees in other countries as well. We have them in the United States. The mason-bee that Fabre first studied builds her house on the surface of a small boulder. She starts it first by building up a cell, a sort of little jug about big enough to hold her body. She uses little bits of sand and gravel which she cements together very neatly to form the little

jug. She makes the cement or mortar by selecting just the right kind of dirt and sand which she mixes with juices from her mouth. Her jaws are shaped just right to mix and lay on and smooth the mortar. She uses them just like a mason uses a trowel when he builds a wall with stones and mortar.

When she gets her little jug finished, she, like other kinds of bees, visits the flowers for nectar and pollen. She puts the honey in the jug, then mixes the pollen with it and thus makes a honey cake. It was while the jugs had honey in them, but not yet closed, that the boys found them. When it is about half full she places an egg on the cake. She next makes a neat cover to the top of the jug. Now the little grub that is to hatch out will find a fine store of delicious food to live and grow on.

The bee next builds another cell, just like this first one, right beside it and cemented solidly to it. This is also furnished with honey cake and an egg put on top and the cell sealed up with cement. She keeps making these little cells until there is a group of from six to ten, each with its honey cake and an egg.

Now to make things more safe for the little family, the bee mother builds a thick covering of cement over the whole group of cells. When finished, the whole house is about the size of half an orange. The thick, hard round cement roof keeps away the rain, frost and snow. It protects

them from wasps and other insects that go hunting around for fat grubs. It keeps out birds that are always on the lookout for just that kind of food. It may be a long time before the family can come forth, therefore, especial care must be taken to protect it.

When they are hatched out, the tiny grubs quickly grow to be big ones. Then they spin soft linings for their little rooms and go to sleep to await the time when they will wake up full grown bees, with legs, wings, eyes, jaws, and all the parts of a beautiful flying insect, instead of fat white grubs. This family is made up of both brothers and sisters. They must next work their way out of their little cells. Then they are free to begin new bee life.

Soon new mothers start in as masons, first selecting a stone for a foundation, and building the house and filling the rooms with food and eggs as their mothers did.

There are many kinds of mason-bees found in different countries. That is, bees which make their houses with the use of cement or mortar which they make themselves. But they do not all build their houses like the one which Fabre and his pupils found. Each kind has its style of house, and its own choice of the kind of place to build it in.

In this country one kind makes little cells on the underside of a flat stone. There are some kinds that do not build their nests wholly out of mortar, but use holes in fences, buildings, trees or stone

walls. These holes they clean out and use their own mortar with which to finish them. One kind makes tiny vases out of its cement which it fastens to stems of plants. A honey cake and an egg is placed in each vase. Because it makes these vases, it is called a potter-bee.

Each of these sorts of bees, has wonderfully interesting ways of doing things. There are great numbers of the different kinds. So many, that people have found out the ways of but a few of them. There are sure to be some kinds living about every home. Many are so small and go about their work so quietly and quickly, that we never see them. If any one would watch and study some of them as carefully as Fabre did his mason-bee, he could certainly tell wonderfully interesting stories about them.

A CATERPILLAR REGIMENT

Not long since, Elizabeth received a letter, part of which is given here. The things spoken of in the letter are shown in the pictures.

"While searching among the trees and bushes with Alice, I found on a twig of a white oak tree a small thickened band wrapped about the twig. On looking at it very carefully you can see that the band has an outside layer which you can see through and that it covers a great number of little dots. These dots are little eggs standing on end and packed closely together. There are something like four hundred of them or even more. Now what kind of an animal can lay four or five hundred eggs in one nest? Well, it is the moth of the tent-caterpillar. All the kinds of moths and butterflies lay some kind of eggs from which are hatched some kind of caterpillar.

"I am sending you a twig on which is a band of eggs of the tent-caterpillar. I cut it off an oak tree near here.

"If you tie the twig, which has the band on it, tightly to one of the small branches of a tree near your home where you can watch it, you can see what happens when the eggs hatch. You can use an oak, an apple, a cherry, a prune or an apricot tree. In tying the twig on be sure to tie it firmly

and use fine thread. If a coarse string is used it might be hard for the tiny caterpillar to get over when it first hatches out.

"At this time of year (spring) if you look carefully among your oak trees and fruit trees you may find a nest of eggs of the tent-caterpillar which you can watch on its own tree, or if it is too far away, you can cut off the nest twig and tie it to a right kind of tree near your home. Most people do not like these tent-caterpillars on their trees but just one nest won't matter much. And if we can learn something about the way those little animals live and manage to take care of themselves, I think it will do us some good."

STORY OF THE TENT-CATERPILLAR

The tent-caterpillar moth lays her eggs in a band around the oak twig in the summer time. She carefully covers the eggs with a substance which when dry gets hard and will turn the water off, so that the eggs are kept dry through the winter.

There they stay through the fall and winter tucked away in their well made nest. About the time the oak leaf buds begin to open in the spring into leaves, the little tent-caterpillar eggs hatch. They are very tiny little caterpillars at first but Oh, there are so many of them. Small as they are, they seem to know just what to do to take care of themselves in the big world into which they have just come.



FIG. 9.—The tent-caterpillar. The band of eggs on a twig. The tent with tiny caterpillars in it. A full grown caterpillar. The cocoon. The tent-caterpillar moth. Not all of these would be found together as in the picture.

They are sociable little people right from the start. They stay together in a great company, just as soldiers do, so we might call it a regiment. They all dress alike in a uniform and that is like soldiers. Down the limb they march until they find a corner which seems to them good enough in which to build their tent. Such a corner is where one limb of the tree branches off from another. There they busily work at weaving a web that looks like some kind of a spider's web. They use it for a house or tent. This is the reason they are called tent-caterpillars. The cloth of the tent is woven from a fine silken thread which they spin from their bodies as do spiders. They spin this thread wherever they go.

When they first make their tent it is rather small, but big enough for the tiny little people to get into. They crowd in at nights and on cloudy days. There they keep warm and are sheltered from wind and rain and any insect enemies which may be after them. When the sun comes out warm, the little fellows crawl out and go off to the ends of the twigs or branches of the tree for the green leaves which are their food. They eat away on the leaves until they are unable to eat any more, then they crawl back to the tent to rest and sleep in safety.

How do they find their way back to their tent? Well, I am not sure, but it looks as if they had a good way since they spin a thread wherever they go. They could follow that line of thread back.

Then they go over the way so often that there gets to be a good silken trail on every limb back to the tent.

That little thread is sometimes of great use to them. If ever you find one of these caterpillars swinging at the end of its rope you can see how it uses its mouth and feet to gather up the rope as it climbs back to its place on the limb.

As each little caterpillar goes out every nice day and feeds on the leaves it grows very fast and soon becomes a big caterpillar, more than an inch long. The whole company keep making the tent bigger and bigger to suit their larger size. It might get to be as much as two feet across.

But after some time when they have eaten a lot and grown all they are going to, they do not go back to the tent. Each one then goes off by itself. It seeks a good place to hide in. Then it spins a silken bed for itself. This is fastened by silk threads to the sticks or leaves where it is hiding. The silken bed is called a cocoon. Inside of it the caterpillar slowly changes into a moth. This takes some weeks, perhaps as much as three. The moth comes out of the silken cocoon and at first it is very quiet, but soon it is strong enough to fly. It hides away in the day time and flies about at night. One may fly into your room through the window some time when the light is shining.

Many other moths and other insects besides this one may come in through the window at night drawn by the light.

After some time, when it is ready for egg laying, it seeks a tree that will give the right kind of leaves for food for tent-caterpillars. It likes the white oak best, but some others will do. It lays a band of eggs around a small twig and covers it over with something that is hard when it gets dry and protects the eggs through the winter. This band is like the one which was sent to Elizabeth. It stays on the tree till next spring and the story begins again with the tiny caterpillars marching down to find a good place in which to make a tent.

If you find any eggs watch them and you will see that they do just what this story tells you.

There are several kinds of tent-caterpillars. But they act much in the same way. Some make their tents somewhat different from the others, or they may have different likes and dislikes about their food leaves. One likes oak leaves the best, whilst others seem to prefer apple or cherry leaves.

There is one thing sure, if the mother moth puts her eggs on a certain tree the caterpillars must eat just that kind of leaves or go without. They have learned the lesson of "Eat what is set before you and ask no questions." Mother seems to know just what the children need and she does her best to manage that they get it. But suppose she should make a mistake and lay the eggs on a wrong tree, a tree that had leaves which the little children could not eat. That would be terrible. There would be about four hundred little caterpillar babies that would starve to death. But the

mother moth seems to be very careful. I have not found any eggs on the wrong tree. I think it is wonderful that such little people with such small heads know how to take care of themselves in such clever ways.

MUSHROOMS

When winter has gone away the ground begins to get warmer. The soft spring rains come. The warmth and rain wake up the seeds and the roots of the plants and they all start to grow.

Soon the hills and fields are green. In the forest the buds of the trees are opening and will soon cover the branches with fine green leaves. There is plenty of food for the birds and insects and so they come forth to begin their lively and joyful summer life.

One spring morning, after showers of rain, we took a walk through the fields and woods. On every side there seemed to have just popped out of the moist ground many kinds of plants that are not green. They are called mushrooms. Because they grow so quickly, it is sometimes said that they "spring up in a night." We found that some of them do seem to grow up in a night, but not all of them spring up so quickly. Some kinds grow so slowly that it may be a long time, even months, before they reach their full size.

There were many different shapes. Some were like umbrellas; some were round balls and others shaped like stars. Some did not grow from the ground but from the sides of logs or trees. Many of these were like shelves growing out from the log.

They were of many different colors but only a very few were green and their green was not like the green of grass or of the leaves of trees.

The umbrella shaped ones were the most numer-

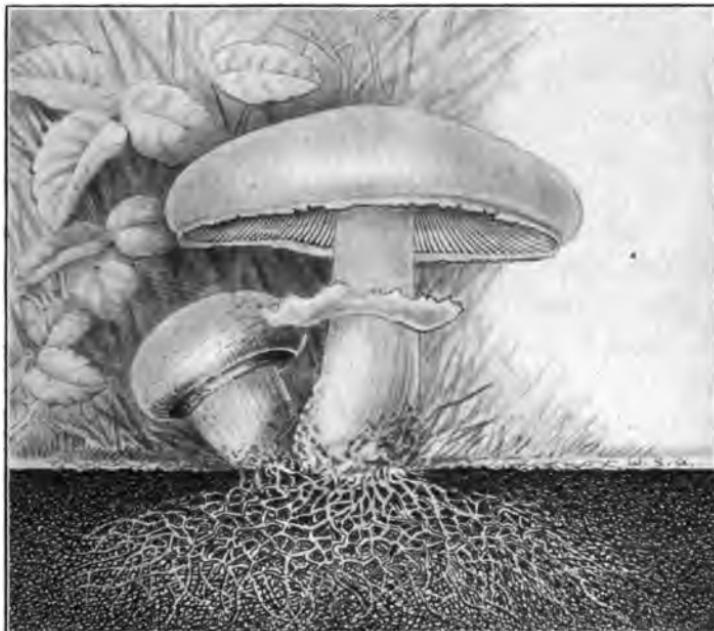


FIG. 10.—The common edible mushroom. The ground is shown as if cut away to show how the mycelium grows in it.

ous. These were not all alike, some being large and some very small.

We were told that many kinds are good to eat but that some kinds are very poisonous. Now since some that are poisonous look like those that are good to eat it is dangerous to make a choice unless you know them very well. As we did not

know how to tell a good mushroom we asked a man who has studied mushrooms and knows, to tell us about them. He showed us some of the good kinds and we gathered them to take home and look at more carefully.

We first examined some of the umbrella kind. One of the first things we learned, and this surprised us, was that this umbrella part which grows up out of the ground so quickly is by no means all of the plant. There is a part that grows in the ground. By digging the earth away very carefully from the bottom of the umbrella stalk we found it fastened to a delicate white stuff which looks like cotton. This runs from the umbrella stalk into the ground like roots but not strong like the roots of other plants. These threads are so fine and delicate that it is hard to find them in the ground except at the very bottom of the umbrella stalk. But people who have studied very carefully how mushrooms grow, tell us that these fine cotton-like threads grow a long way in the ground or log on which the mushroom is growing. This is the main part of the plant. It is called the mycelium. It lives and grows sometimes for more than a year before the umbrella part springs up out of the ground and its purpose is to gather food for the mushroom. The white cotton-like mycelium gathers food from rotting leaves, wood or grass roots that may be in the ground. If the mushroom grows on a log, the mycelium grows in the rotting part of the log to get its food.

When the mycelium has gathered enough food to nourish the growth above the ground, a part will grow up from the surface of the earth or out from the side of a log in the form of a little umbrella. On the under side of the umbrella part are the tiny things that act as seeds of the mushroom. They are called spores and are so small that they seem like very fine dust when touched. The top of the umbrella is called the cap and the handle, the stem. Most of the umbrella kinds that we gathered had little short thin curtains on their under side which run from the stem out to the edge of the umbrella. These little curtains are called the "gills" of the mushroom. The fine dust of spores is formed on these gills.

The spores, being so small, are carried away by the wind before we can see them properly, so we took some of the umbrella shaped mushrooms home and cut off the stem of one close up to the umbrella top and laid it carefully, with the underside down, on a sheet of paper. We then covered the mushroom top with a glass tumbler to keep the air from blowing the spores away. After some hours the spores had fallen down from the gills just right to make a beautiful picture of the gills on the paper. This is called a spore print.

A single spore is so small that we cannot see it by itself. But when a lot are gathered together they look like colored dust. If you look at them with a microscope, they are seen to be little round or oval things.

If one of them gets in the right place it will grow into a tiny white thread. New threads will branch out from this and these threads will branch again and again until it makes the cotton-like mycelium. In this way the fine threads of the mycelium grow through the rotting log or decaying matter in the ground gathering food for the quick growth of the



FIG. 11.—The mushroom called boletus.

umbrella. Thus the spore grows into the mycelium and the mycelium makes the umbrella above the ground, and the umbrella makes the spores and the spores wafted away by the wind to a new place start new mycelium which is ready to go on with the program once more.

One kind of umbrella shaped mushroom has on its underside, instead of little curtains, a number

of little holes and the spores come out of these tiny holes. We made a spore print of this one also. The name of this one is the boletus.

The umbrella shaped mushrooms are not the only ones which bear spores. Every kind of mushroom has spores. The part that grows up



FIG. 12.—The morel.

out of the ground or from the side of a log or trunk of a tree is the part that forms the spores. It is sent out on purpose to make the spores which are generally found somewhere on the surface of the mushroom.

The mushroom called the morel, instead of an umbrella top has a pointed top. Its surface is wrinkly and the spores are on this surface.

The coral mushroom has a branched top looking like some kinds of corals. The spores are on the surface of the branches.

The puff-balls are mushrooms which have in the place of the stalk and umbrella top, a ball shaped



FIG. 13.—Coral mushroom.

part. The spores are formed inside of the ball. When they are ripe the ball is easily broken. If you step on a ripe puff-ball a little cloud comes out with a puff. This is really a little cloud of spores.

We found one very curious kind of mushroom called the geaster, or earth star. It is really a

kind of puff-ball with a star shaped collar around its base. When the geaster is wet the rays of the star open and stretch out wide. As it dries up the rays rise up and close tightly around the ball in the center. If you put the dry one in a saucer



FIG. 14.—Puff-balls.

of water the rays will again open and stretch out right before your eyes.

Thus every kind of mushroom has a place on it where the tiny spores are formed in very great numbers. Why are the spores so very small and why are so very many made? Well, as nobody takes care to plant all these different kinds of mushrooms, each mushroom must see to that for itself. The spores are made very small so that,

like very fine dust, the wind can carry them away long distances. There are such large numbers of them formed so that some of them can be sure to get planted in just the right kind of a place to grow.

Every kind of mushroom needs a certain kind of place where it can grow best. If thousands upon thousands of the spores of a mushroom are scat-

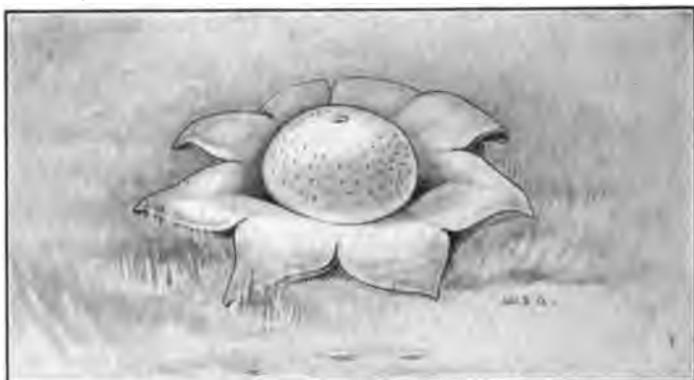


FIG. 15.—The geaster opened when moist. The star shaped collar closes on the ball when dry.

tered far and wide some will be sure to fall in the right places for that kind of a mushroom. In that way each kind keeps itself alive year after year. If there is a good place over in another woods for a certain kind of mushroom the wind will very likely carry some of its spores over there and a new lot will spring up.

Just a few kinds of mushrooms are talked about in this story but there are hundreds of others.

You will find it great fun to look for the different kinds and find out the places each one likes best.

Sometimes the umbrella shaped mushrooms are called toadstools. I suppose that name was given them long ago when some people thought that the toads used them for stools. I think they would make better umbrellas than stools. Don't you?

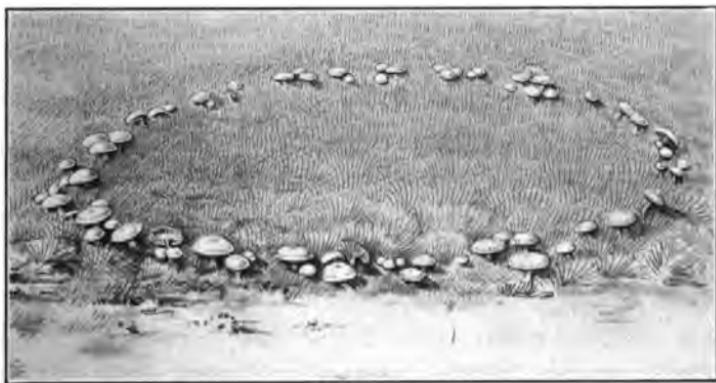


FIG. 16.—A fairy ring.

Sometimes one kind of mushroom is found growing in the lawns or fields in such a way as to make beautiful rings. People call them fairy rings. Long ago it was thought that the fairies made them come up in rings so that at midnight they could come and dance in the center of the ring. It does look mysterious to see a lot of mushrooms standing up in the grass in the form of a ring like a lot of children playing a game.

One explanation of how they come to grow in a ring is this.

The sort of mushrooms shown in the picture is not the only one that grows in a ring. Why mushrooms should come up in this way is such an interesting question that our Government's Agricultural Department set some of its scientific men to study it at one of its experiment stations. The explanation given is that some spores of the mushroom drop in a good place in the lawn or field. They start the mycelium to growing in the ground. From this spot as the mycelium grows it finds good fresh ground in front. What is behind is not so good because the mycelium has just used it. As it grows away from the starting point it soon becomes a circle. This growth may go on for years before it bears any mushrooms but when they do come up of course they are in a ring. These rings where the mycelium is growing is often shown in the lawns long before any mushrooms come up. They make rings of brighter colored grass under which the mycelium is growing. There are a number of such rings in the lawns of the University Campus.

The rings can only form where the ground is not disturbed for a long time such as in lawns, permanent pastures or woods. In some places the rings are so large that it is thought it has taken hundreds of years for them to grow this way. I am sure if I had a fairy ring in my lawn or anywhere I would not let any one destroy it.

I have said that very many kinds of mushrooms are good to eat. I must now tell you that some

are very poisonous. You should never try to eat any kind of mushroom without knowing for certain that it is one of the good kind. It is best to learn this from some grown up person who knows mushrooms well. Some of the most dangerous ones look so much like some of the good ones that any one not knowing them well could easily be mistaken. Some people say that you can tell a poisonous kind by boiling the mushroom with a silver coin. They say that if the silver turns black, it is a poisonous mushroom. This is a mistake so don't trust it. One of the most common of the good kinds comes up in the pasture fields. Many people know this kind well and go out in the spring after warm rains to hunt for it in the fields.

This is the kind that is planted for the market. Perhaps some one near you raises this mushroom. It would be interesting to visit the place and see how the mushroom gardner makes them grow. He uses a cellar or cave where it is cool and damp. He gets very rich earth and starts the mushrooms by planting in it a block of dirt which has the mycelium in it. This block of dirt with the mycelium in it is called spawn. When it is planted in the moist rich earth, the mycelium grows out from the block of dirt. The mycelium spreads all through the rest of the rich earth the same as it does in the ground in the fields and when it gathers enough food it puts up the umbrella shaped part in large numbers. These are gathered to sell for food.

SOME TOAD STORIES

A HOMELY FRIEND

The boy was helping Aunt Hannah prepare her flower beds. They were both down on their knees planting seeds, and crumpling up the clods with their hands, to cover the seeds with fine soil. Aunt Hannah got hold of a clod that was soft but would

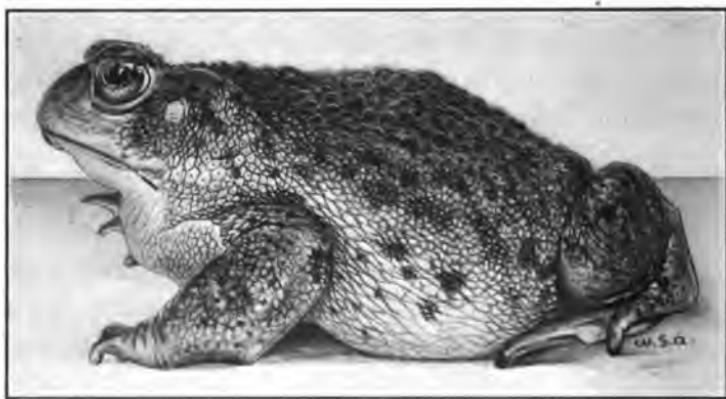


FIG. 17.—A common California toad.

not crumble as she rolled it in her hand. "What a funny clod," she said, "Oh it's a toad" and she let it drop in a hurry. Of course the boy laughed, and Aunt Hannah, after making a wry face and saying an "Ugh" or two, laughed too. The poor toad wasn't hurt very much and hopped under

a plant and snuggled down among the clods. As he looked just like a clod again, he thought he had hidden himself once more.

Aunt Hannah did not try to drive the old toad away. She was very glad to have it stay, even if it were so ugly that she did not like to touch it. For the good old toad was a great help to her flower beds. She had had great trouble with the insects and slugs eating her plants as soon as they came up. But after the toad came it caught hundreds of the insects and slugs and this gave the plants a chance to grow. Indeed she thought so much of it, that you could hardly buy it from her. But you might think, why is such a good fellow so very ugly? Well now; there is a very good reason for the toad's being ugly.

You see it is such a harmless animal, it couldn't take care of itself by fighting as some animals do. It has no sharp teeth to bite with nor sharp claws to scratch with. So almost any animal can whip it in a fight. Then it can not run fast so as to get away from trouble. But if you look at it carefully you see its body is dark mud-color, with dirty looking blotches, and the skin is rough with warts. This makes it look like a lump of dirt. Thus, when it sits low down and very still among clods or on rough ground, you would have to look closely or you would not see it at all. When hawks, cats, dogs and other animals are hunting for food they are likely to miss seeing the toad. Then it hardly ever comes out of its hiding

place till it begins to get dark, and that makes it still harder to be seen. A very curious thing further helps it hide itself. It has a strange way of changing its color a little, so that it may get a lighter grey on light colored ground or a darker brown on darker ground. Then there is another thing that helps guard it against some of its enemies. When an animal touches it, a liquid comes out of its skin that is very bad to taste and it is somewhat poisonous, so that if a dog or other animal picks it up with its mouth, it is glad to drop it and not to try it again. So you see this quiet, helpless, ugly, slow toad is taken care of by nature.

But it is not altogether ugly for it has beautiful eyes. They are bright yellow and gleam from his homely head.

While the good old toad cannot harm children and animals, even if they are no bigger than itself, it is a hobgoblin to insects, worms and slugs. Here is where its ugliness helps it again. As it looks like an unsightly clod, the bugs and flies crawl and fly close to it thinking there is nothing around, but clods. But they are greatly deceived when one of the clods turns out to be alive and snaps up the poor insect as quick as lightning.

The toad is a slow sleepy fellow, but there is one part of it that is quick as a flash. That is its tongue.

The children caught an old toad and put it in a box. They caught some flies and caterpillars and slugs and put them in the box with the toad.

Then they put a sheet of glass over the box to keep the flies in, and watched what would happen. A slug was crawling along the side of the box and, quick as a wink it was gone. No one saw how it went away. They watched more closely. This time Bess said she saw the toad's mouth fly open. Tom said he saw a pink flash and a fly disappeared. Well, then they watched still more closely and found that what happened was this. When a fly or a caterpillar moved near the toad its big mouth flew open and a long pink tongue shot out, caught the insect and shot back again and the mouth snapped shut. It was all so quickly done you could not see it if you did not look very sharp.

Then I took up the toad and opened its mouth and there at the front part of the bottom of the mouth was the tongue drawn up in a little lump. When pulled out, it was long and slender and covered over with a sticky stuff. To catch a fly, the toad would open wide its big mouth and throw out this tongue, like a long ribbon, against the fly and the sticky stuff would hold the fly fast, and the toad would jerk it back into its mouth which closed with a snap. What a fine fly-trap! Though its body is like a clod that is not easily seen, it has a good bright eye, a big mouth and a long sticky tongue, that is as quick as lightning. Strange to say, the toad does not seem to see an insect until the insect moves. If the fly keeps perfectly still the toad does not try to catch it, but if the fly

makes the slightest move then it is swept off in a wink.

There is another pleasing thing about a toad. It has a nice little song. Not a coarse and rough one like the croaking of some kind of frogs. Its song is like a very soft and gentle whistle.

In countries where the winter is cold, many plants go to sleep in the fall until spring. Some animals also hide away for the winter sleep. The toad is one of them. It finds some hole in the ground, or digs down into the earth and in its hiding-place, sleeps till the warm spring rains come. Then it wakes up with the other winter sleepers and then you can hear its gentle song. It, like every body else, is glad when winter is over and spring has come. This song is one of the early signs that plants, insects, flowers, squirrels and many other animals are waking up and soon the grass and flowers, birds, butterflies and bees will all be busy again.

The toad is generally quiet the rest of the year. But you can make it sing a little song if you stroke it gently with your finger in just the right way.

The toad is a great friend to the gardener, because it catches such great numbers of insects, caterpillars, slugs and worms. People who understand this, are very careful that no harm comes to the toads. They may go to lots of trouble to get toads for their gardens. A little boy friend of mine, learned that toads are fine for gardens.

He thought he would find some and try them, and here is the story of his troubles.

LITTLE WILBUR AND HIS TOAD TROUBLES

There was a pond near little Wilbur's school. At noon and recess the children would often play and "splash" along the edge of the water. In the spring hundreds of toads came to the pond to lay their eggs. When the eggs were laid, the toads would come out of the water and start for their old homes. Some went this way and some went that. Some of the boys who did not understand toads and all the good they do, would run after the poor things with sticks and stones and I am very sorry to say killed very many of them, before they got back to their homes in the different gardens.

I suppose that that year the insects and slugs in many gardens, had a jolly time eating up the plants, because the poor toads, that had homes in those gardens, never went back.

A little boy, named Wilbur, had read in his story book, how in France the gardeners kept toads in their gardens to keep the plant-bugs and slugs from eating every thing. Well, when he saw the toads hopping around on the banks of the pond he thought about the French gardeners. At his home, there was only a very small front yard. His mother had a few flower beds in it. He thought "I'll just take home some of these toads and put them in the flower beds as the French gardeners do and leave them there to take care of

the flowers." He did not tell anybody what he was going to do for fear he would be laughed at. So he slipped away from the other boys with whom he was going to school, some of whom were stoning the poor things and caught two of the toads, to take them home, and put one in each of his trousers' pockets. To keep them quiet he carefully covered each one with a small bunch of grass.

Well he had to stay in the school-room with those toads in his pockets all the remainder of the afternoon, till school was over for the day.

Now, the toads behaved very well and kept very quiet down in the bottom of the pockets. But Wilbur could not keep his thoughts off those toads. He slipped his hand carefully down into one of the pockets to see if that toad was still there. It was there sure enough. Just to see if it were all right he gently smoothed its back with his fingers. The toad must have liked that for it answered by singing its soft toad song. When the children heard the toad song of course they all looked up. But as the song came smothered out of the bottom of the pocket, nobody could tell just where it came from. Soon they all got busy again.

At first Wilbur was startled to have the toad sing right out in school. He was afraid something would happen to him if it were found out that the sound came from him.

So he kept very quiet for a time. But he could not keep from trying if that toad would sing again if he stroked it. He tried it and sure enough

out came the song again. This time every one knew that there was certainly a toad in the school-room. The next thing was to find out where it was.

Now as Wilbur wanted to get those toads home he should have kept very quiet and let them alone, but he just couldn't do it. He wished very much to find out if the other toad would sing if he stroked it. So when he thought he was safe, he rubbed the other toad's back with his finger. Sure enough toad number two sang out louder than the other.

When Wilbur thought he was safe he didn't notice that Fanny Jones was watching him and saw him reach into his pocket just before the toad sang out. So up went her hand. The teacher asked what was wanted. She went right up to the teacher and told her that Wilbur Jackson had a toad in his pocket.

The teacher thought that it was a horrid thing to have toads in one's pocket and right in school too. So she made Wilbur march up and take the toads out of his pockets. She gave him an old crayon box to put them in. Well, he put one in and while he tried to put the other in, the first one hopped out and across the room. Then while he went after that one the second one hopped out and across the room in another direction. This made the teacher jump up on a chair and most of the little girls get up on top of the desks. The boys of course, laughed and shouted while they had a chance.

Wilbur kept after one toad then the other. I am afraid that he was only pretending to catch them. At any rate they hopped all over the room and it was quite a while before he got both toads safely in the box and the racket in the schoolroom quieted down. Then the teacher, before the whole school told him what a disgraceful thing it was to have those ugly toads in his pockets, and to bring them into the school.

Then she sent him up to the principal of the school, to have him punished. As he went sorrowfully along by the other rooms on his way to the principal's room, the other teachers who had heard the news, looked daggers at a boy who would have toads in his pockets. Ugh! The principal switched him and sent him back to his room in disgrace.

Word was sent home to his mother, how he had toads in his pockets in school. His mother felt the disgrace also. She had him take off his little trousers and put them into a tub of soap and water, and pound them with a stick.

You see how all this trouble came about. It was because all these people did not understand about the toad, how useful and innocent it is. And they misunderstood a little boy, who was kind to the innocent animal and was trying to do good in following the ways of the wise gardeners of France.

When I saw the little boy, I felt very sorry for him and tried to help him get some other toads for his garden. But I felt sorrier for people who do not know better about good old useful toads.

AN INNOCENT PET

Toads make very innocent pets. All you have to do is to have a good place for them to live in and they will take care of themselves. They like a dark damp place to hide in, in the daytime. A hole in the ground under some bushes or a board, under which they can crawl suits them. I had one that stayed under a doorstep in the daytime. When it began to be twilight, it would come out to look for its food. As no one ever hurt it and it often got some petting it became quite tame.

Toads live many years if no hard luck comes to them. One was known to be in a garden for thirty-six years.

A toad is very fond of its own home. If it is carried away, it will do its best to get back to its old home. This makes it hard to start an old toad in a new place. If you find a toad and wish to keep it in your garden, you may be disappointed. For it is pretty sure to try to get away to find its old home. You will have to keep it penned up some way till it gets to feel at home in the new place.

The better way would be to get some little young toads that are just leaving the pond where they were hatched. At that time they are starting out to find a home and if you have a good place, they may stay in it.

A still better way to do, if you can, is to get some toad's eggs from a pond in the spring and put them

in a glass jar or dish in your garden and let them hatch and live there till they get to be little toads. Then some of them will stay in your garden.

Then too you will have the fun of seeing how toads grow from eggs. It is an interesting story. For as stupid as toads look, like all other animals, they must know enough to provide for their young. This is a story of how the children tried to find out about the way toads get their start in life.

WHERE THE TOADS CAME FROM. A PICNIC

We learned that toad's eggs were laid in water and hatched there. So off we started to find a ditch or pond where some eggs might be found.

It was a beautiful spring morning. Toads lay their eggs in the spring-time. We took along a lunch so as to make a picnic of our tramp. We had a glass jar to put the eggs in, if we found any, and a little net on the end of a stick, like a butterfly net with which to catch a toad or two. Tom carried the jar, Bessie the net and I carried the lunch.

Well, we had a long tramp and saw many interesting things that there is not time now to tell about. For the birds and insects and butterflies were starting up their spring work. By and by we got to the top of a hill and away down at the bottom through the trees, we saw a pond. It was still a good way off. It wasn't near noon yet, but I could see that the children were a little tired and began hinting about

the lunch. Tom was afraid the cake would get smashed if we climbed over any more fences. Bessie thought that it would be better to eat the lunch before we got our hands on the toads and eggs. We were under a nice tree so we decided it was a fine place for a lunch. We spread it out on a bit of ground with a readymade moss table-cloth and saved the cake from being smashed while climbing a fence.

While we were eating, Tom kept looking over at the pond and talking about the toads laying eggs in it. He was puzzled about one thing. If it be true that toads like their own homes and will not stay anywhere else if they can help it, how is it they ever go to ponds so far away?

Well, that is one of the most interesting things about a toad. The common garden toad's eggs are of a kind that can only hatch in water. With some other kinds of toads it is different. But our old toad must find water in which to lay its eggs. Without water they would all dry up and never hatch. So when the toads in spring come out of their hiding places, they soon get ready to lay their eggs.

The first thing to do is to find a pond. Now how can a toad find a pond? Some people have thought toads are so interesting that they have watched them and studied them year after year. They tell us that when the toad wishes to lay its eggs, it tries to go back to the same pond where it, itself was hatched.

You see when the little toads leave the pond where they started life, they hop and crawl away from it to find a good home to stay in the rest of their lives. They, in their slow way, sometimes get a long distance from the pond before they find a home to suit them. Then it may be three or four years before they are old enough to lay eggs, but when that time comes they start back for that same pond.

Bessie said that she couldn't understand how a toad could find its way back to the pond because it was so low down on the ground that it couldn't see very far. There were so many sticks and stones and logs bigger than it that it couldn't look over. Besides it has no path back to the pond. I think myself, that it is hard to understand how they can do it. Tom thought that perhaps the toad climbed up on a high stump and looked all around. But that can't be, for our old garden toad can not climb like a tree toad. Then they say toads cannot see very far, any way. "Well then," Tom said, "I don't believe they can find their way back."

We decided to hurry down to the pond and see for ourselves if any toads had gone back there. As we got up I must say that there were only a few crumbs left from the lunch for the birds to find. We gathered the papers up and rolled them into a tight wad and buried it in a hole in the ground, so that our lunch place would look as clean as we found it.

We pushed on and before long came to the pond. Off came shoes and stockings, of course. If there were no toads or eggs the wading would well pay for the long walk. But soon Bessie cried out "Here's a toad." The toad was a big one and was crouched down in the edge of the water and before we could catch it, it swam out into water too deep for us and dived down to the bottom. We could see it through the clear water. It soon came up and floated and swam around at the top of the water. But it was so far out we could not get it.

While the children were wading around Tom called out, "What's this stuff sticking to these water weeds?" I answered, "It looks to me like toad's eggs. Bring some of it in." Tom grabbed at the queer stuff two or three times with his hands but shouted back, "It is so slippery that it slides through my fingers." I told him to be careful with it and come and get the glass jar. He put the glass jar under some of it and let it slip in and then brought it to the shore. Sure enough it was a lot of toad's eggs. But if some one who knew about it had not told you, you would never guess it.

The eggs were a row of tiny black dots in a string of something that looked like a clear jelly. The strings of eggs were very long and hung to the water weeds in loops. Tom got some pieces of the slippery strings of eggs into the jar.

The children thought that they could be sure that these things were toads eggs if they could see some toad laying them. So putting the jar into a

safe place we went along the shore to look for toads. We soon found that there were plenty of toads in the pond. This looked as if toads do come to the pond. But Bessie said "perhaps these toads always live here." Tom declared that he was "going to come back to this pond when the toads were through laying eggs, to see if they still lived here." That was a good idea. It did not take long to catch three nice big toads. Then we were ready for our march home with our jar of eggs and the toads wrapped in the net.

As we were starting Tom said "Why can't we see some toads coming to the pond?" We decided to look through a part of the woods and a field near the pond. Sure enough we found many toads going toward the pond. But they traveled so slowly, and would often stop and snuggle down trying to hide when we came near, that we could not wait long enough to follow them all the way to the pond. But I may say here that several days after, we made this visit again and we found only a few toads in the woods and field and very few at the pond. These few may have been those which have their homes in those places. All this looked as if the people were right who say toads came from distances to the pond and then go back again.

Then we picked up our jars of eggs and net of toads and trudged home. That was easy for us to do because we can see a long distance and have good memories to help us to find the way back.

But it is hard to understand how a poor little toad can do it. But it just must do it, or soon there would be no more toads. So it has its way of knowing and it is for us to find out what it is.

There is another thing worth remembering and that is when egg-laying time comes the timid old toad must become very brave. For think of all the dangers it must meet when it leaves its snug hidden hole under the bush or door-step and starts out alone for a long journey. There are hawks and owls ready to pounce down on it, skunks and 'possums, coons and weasels and many other kinds of animals and worst of all, snakes. And the poor toad can't fight or run away fast enough from any of them. Snakes are especially bad for it, for they seem to like toads very much and they can catch them so easily. I once found a snake with a toad fast in its mouth too big for it to swallow. There they lay neither toad nor snake able to do anything. But how much they suffered. Of course I took them apart and sent the snake about its business and carried the toad far away hoping they would not meet again.

Then there are other dangers. For example, we saw on a road we had to cross, some toads that had been crushed by wagon wheels. Those toads were most likely on their way to the pond, and got run over when they were crossing the road. Thus many a poor toad which starts out on his pond journey, never lives to get back again.

We reached home all right, tired but happy that

we had secured what we had gone after and that we had had the good luck to really see the toads on their spring festival of pond finding and egg laying. Our next fun was to take care of our toads and watch the eggs hatch.

HOW A TOAD BEGINS LIFE

Tom and Bessie each filled a glass jar with water, and put some eggs into them. I put a few into a tumbler and put it on my desk. In each we had scattered some sand over the bottom, and put in some water-plants and green scum brought from the pond, so that when the eggs hatched, the little tadpoles would feel at home.

The children told their teacher about it next day and she was delighted and wished them to bring some of the eggs to put into the nice little aquarium which they had in the school-room. That was all very fine, for now we had four different places in which to watch the hatching. Next the three toads had to be taken care of. We were very anxious to see if any of them would lay eggs. One was very fat and we guessed it was a mother toad full of eggs.

We found a large glass jar and filled it about half full of water. We put two bricks into it. The bricks were placed in such a way that they rose out of the water a little; these were little platforms for the toads to sit on when they became tired of swimming around in the water. Then the jar was covered, so that they could not get out.

We watched and waited but the lazy things didn't do a thing but just sit around. Of course after awhile bed-time came and we gave it up for the night.

But next morning, Oh my! There were the strings of toad's eggs, long jelly-like strings, each with a row of black dots in it. They looked like long slender bead necklaces. The toad that was so fat yesterday was now quite thin. She must have been the mother toad which laid the strings of eggs. They must have been just freshly laid, for the jelly part was very slender. But after a while, it soaked up water and was a good deal thicker. When the whole mass of strings swelled with water they looked so big that it did not seem possible that one toad could have laid them all.

The children started to count the eggs. When they got up to 357, they saw that they could not carry it through, there were so many. And no wonder, for some grown people who have taken great care in counting toad's eggs, tell us that one toad sometimes lays many thousands, sometimes even more than ten thousand eggs.

What could we do with so many eggs? We had already as many as could live in the jars, and no one wished to see these eggs die so I suggested that they take them back to the pond. That plan was hailed with joy for it meant another picnic and wading fun and another sight of the pond-life. This was done as soon as we could get away next day.

But it was now time to look after the eggs in the jars. The eggs when first laid, were about the



FIG. 18.—A single strand of toads eggs hanging from a water weed. Four tadpoles newly hatched, three hanging to a blade of water weed. Tadpole with gills showing. Four figures of tadpoles showing changes to a toad.

size of a pin-head. In a day or so they were larger. Then in another day or two we could see that instead of a little round egg, there was a something a little longer and it wriggled. Then in another day out swam a little black tadpole. The egg had grown into that little animal. These little tadpoles, which the children also called polliwogs, swam out and fastened their heads to the water-plants and hung there very quiet till disturbed. By looking very closely, we could see that each one looked like a round head with a thin flat tail hanging to it.

They were not eating, but just hanging on by two little suckers near where their mouth ought to be.

Out of the side of the head very delicate thread-like branches grew. These were the gills. In this they were like little fishes, which you know breath by means of gills.

It was nearly two weeks before the little things had mouths to eat with, then they were ready for tadpole business. That business is to eat and grow. Now they became very active, swimming about and eating constantly the tiny plants of the green scum and the slime on the sides of the jar and surface of the waterplant. This slime is full of very tiny plants and animals, so small you can only see them with a good microscope. This is rich food for tadpoles.

As we watched them day after day they grew larger. The gills gradually became hidden under folds of skin that grew over them and protected

them while the tadpole still breathed as a fish. What at first looked like a round bead, was seen to be the head and body. One day Bessie came running to say that she believed one of her tadpoles had some little legs. Tom laughed at the idea. But sure enough, on the hind part of the body on each side of where the tail joined on, was a tiny but a real leg. It was small to be sure but a little leg is as much a leg as is an elephant's leg.

Then of course we looked over all the other tadpoles more carefully. We found others with tiny legs that we had missed seeing before. Those that did not seem to have legs at first, were found to have in their place little knobs sticking out which is the way the legs begin. Then Tom said "Of course if the tadpoles are going to be toads they would have to have legs grow on them." So now we watched more closely.

So as time went on, we saw the hind legs grow larger, then the front legs came in their proper places. While this was going on the tail became smaller and smaller. The body gradually became more like a toad's body.

We noticed that the tadpole began to come up to breathe air. As it grew more like a toad, it breathed air all the time. It kept its head out of water most of the time. If it dived it would soon have to come up to get a breath of air, as it no longer breathed through gills.

Finally they became real toads. Very small it is true but with good legs, no tail, with bright eyes

and a big mouth with a toad's tongue ready to catch insects instead of eating plants. They were now ready to leave the water for life on the land.

What wonderful changes are these for an animal to pass through! Hatched from an egg into a fish-like animal, swimming in the water and breathing like a fish with gills and living on plants. Then changing to a land animal with four legs to hop and crawl with and with a mouth like an insect trap with which to catch and eat animal food and with lungs with which to breath air. We had the good fortune to see all these wonderful changes.

The children wished these little toads would make their homes in their garden. They dug some holes in a dark shady spot and placed the jars down in the ground just as if they were ponds. They thought that perhaps when the little toads left the jars, they would only go a little way to find homes to stop in.

What became of the three big toads we had caught? Well, we dug a hole in a cool damp place in the garden and put them in and covered it up with a board. We thought if we kept them there some time, they might get to thinking it was home and stay. After a week we let them out. The first night two of them disappeared, perhaps looking for their old homes, the other one still staid around the garden greatly to the delight of Tom and Bessie.

As to the little toads they were so tiny that it could not be told if any remained in the garden.

But I think some of them did. When they get to be big I am sure some of them will be seen.

There is one thing worth thinking about. If a toad mother lays ten thousand eggs every year and they all live to be toads, would not the world be full of toads in a few years? It surely would be full and running over.

But as toads are of about the same number now as they have been for years, there must be only one or two toads grow up out of all the eggs one toad lays. What becomes of the rest of them? Well, many kinds of animals feed on toad's eggs and tadpoles, such as fishes, turtles, ducks and other water birds, also insect larvæ in the water. Then those that escape all these enemies and live to become toads still have to meet many kinds of animal enemies in the woods and fields.

So for every toad living, thousands and thousands of its brothers and sisters meet some sad fate before they are grown.

Now, since only a few of the eggs escape their enemies, therefore, nature arranges that the mother toad lay thousands of eggs, so that, at least a few may grow up and become mothers and fathers. If there were no bird or animal enemies and no bad luck—no thoughtless little boys with sticks, no wheels to run over and crush them—then each pair of toads would live long and each mother need only lay two eggs to take their place when they die and in this way there would always be as many as we have now from year to year.

THE SILKWORM

ITS GREAT WORK

Before Alice starts to school in the morning I notice that her mother puts a nice silk bow on top of her head fastened in some way to her hair. She calls it her hair ribbon. And I notice that nearly every little girl I see has a big bow on top of her head. Some have silk sashes around their waists.

The boys that I meet seem to think that when they dress up they must at least have silk neck ties. If all the silk hair ribbons and sashes and all the silk neck ties of just this small city were brought together what a large pile it would make. But if all the hair ribbons and all the sashes and neck ties of the whole world could be brought together what an enormously big mountain it would make.

As large as that mountain would be, there would be a much larger lot of things left that are made of silk. There are all the silk waists and dresses, ribbons, silk hats, silk flags and many, many other things made of silk. Then too satin is made of silk and there are many things made of satin. Then again the fine velvets and finest damasks are of silk.

Silk is so fine and soft and beautiful that people like to have clothing and many things about the

house made of it. But it is so expensive that we can not have all our clothes made of it. Then too other kinds of things make better clothing for warmth or rough use. But every body likes at least some silk or velvet things to wear.

Human beings have to go to a great deal of trouble to provide clothing for themselves. The animals which we know, big and little, have their clothing grown right on their bodies. Some have coats of hair like dogs or cats or wool like sheep or fur like the rabbits. The birds have dresses of feathers and the fishes have a covering of scales on their bodies.

But, as you know, we have to get our clothing made for us. Most of what we wear is made from three things: wool, cotton and silk. Of course, some is made from other things as linen, rubber and leather but most of it is made of wool, cotton or silk.

The sheep gives us the wool, the cotton comes from the beautiful cotton plant and the silk worm spins the silk for us. It takes very, very large piles of wool, cotton and silk to make clothing for all the peoples of the world. So the shepherds have many flocks of sheep in many countries for wool. The farmers plant many many fields of cotton plants for cotton. Then think what very great numbers of little silkworms it must take to spin all the silk for the silk and velvet and damask that is used to make the finest and most beautiful clothing, ribbons, curtains, and ornamental trimmings of all kinds.

Thinking about these things makes us curious to know the story of this important little animal. This is our story of the silkworm and its work of spinning the silk used to make the finest of all kinds of clothing. We wish to learn how such a little animal has done such great things as to make something useful and beautiful for peoples all over the world. Of course, the little silkworm does not know she is spinning the silk for people. She spins it for her own soft cocoon or bed where she is to lie until great changes come to her. People have learned how to take this cocoon and unwind the fine silk thread of which it is made and weave it into silk cloth for themselves.

A QUEEN DISCOVERS THE SILKWORM

The story of the silkworm is like a fairy story. The people who first learned the secret of the silkworm lived thousands of years ago hidden somewhere in that great country, China.

There is a story in the old Chinese books that more than four thousand five hundred years ago a Chinese queen whose name was Si-ling first thought that the beautiful soft silk thread that the silkworm winds into a cocoon might be unwound and made into fine cloth. She had the ladies in her court and maids in her house help her. She found the way to unwind the thread. She next had a loom made to weave it into cloth. Then she taught her people what she had learned.

They thought that this was such a wonderful

thing that they kept the secret very carefully hidden so that the people in the rest of the world could not guess how silk was made. When a piece of silk was brought out of China people who saw it would marvel at its softness, its fineness and its beauty and wonder how it was made? It was a great puzzle. They guessed and guessed but all their guesses were wrong. They never dreamed that it was made by a little caterpillar.

In that far away time there were no railroads and very poor roads of any kind. There were no telegraphs nor telephones. China was very far away and few travelers ever went into that distant land. So China was to other countries like a hidden world.

The silk that was made in China was mostly used in that country itself. What did come out to other countries came in packs on the backs of donkeys and camels; mostly the camels were led in groups or bands called caravans. Sometimes it took many many months for the silk from far away China to be brought to the other countries.

All this made silk very expensive. A silk dress would cost as much as its weight in gold. Only rich kings, queens, princesses and princes could have any clothing made of silk. No hair ribbons or neck ties for school children could be thought of in those far away times.

But the great country of China could not keep her secret about silk hidden forever. So after some thousands of years the secret was found

out by a few other people. Then the hidden silk makers of far away China were not the only ones who knew what wonderful stuff the little caterpillars could produce. Stories are told of three ways by which the secret slipped out.

One is that once upon a time, long ago, a beautiful princess in China hid some of the tiny silkworm eggs in her hair and head dress and in that way carried them to a far away country called India. You know Chinese princesses have their hair put up into very large and beautiful head dresses. It takes so much time and trouble to do them up that they let them stay that way a long time. This made a good safe way by which the silkworm eggs could be taken out of China. When the Princess reached India she gave the eggs to the Emperor and explained about them. He was delighted and had her teach his people how to rear the silkworms and get the silk from them.

There is a story that Japan just took the secret by force from the Chinese. It is said that the Emperor of Japan sent some soldiers and captured four Chinese girls who knew all about silkworms and how to make silk. He had them teach his people the secret. After a time Japan got to be a great silk making country. The Japanese were so grateful for what these girls did for them that they made temples in their honor.

Another way by which the silkworm secret got out of China is this. A long time ago two Persian monks went as missionaries to China from a city

now called Constantinople, in the country of Turkey. While in China they learned about the silkworm and how the people made silk. When they started back home they made themselves some walking canes out of bamboo which is hollow. They secretly hid some silkworm eggs and seeds of the mulberry tree in the hollow canes and walked out the long distance to their home city. When they got back they went to the Emperor whose name was Justinian and told him the story of the silkworm and explained how the silk was made. The Emperor was very much pleased. He had the monks teach some of his people how to hatch the silkworm eggs they brought and how to care for the caterpillars and make silk from the silkworm cocoons that they spun.

After a long time, peoples of other countries learned from this country about the silkworms and their work. Some of these countries are France, Italy, Spain, England and the United States. The peoples of these countries planted mulberry trees for leaves for the silkworms to feed upon and got eggs of silkworms and hatched them and made silk.

Just from the eggs which the monks brought in the hollow canes from China to Constantinople, came the many hundreds of millions of silkworms in all those countries.

China and Japan still breed as many silkworms or more than they ever did. And now hundreds of thousands of men, women and children in many

parts of the big world are caring for the little silkworm, finding it mulberry leaves and getting it to spin its silken cocoon. Then from these they are getting the silk threads and making the silk cloth—always saving enough eggs to keep the work going.

OUR FAMILY OF SILKWORMS

Alice and I, when we heard what an important little animal the silkworm is, wished at once to get some and watch them at work.

We have a fine mulberry tree in our yard and there are a number of others near us. Thus we did not have to plant mulberry trees and wait years for them to grow before we could begin. Silkworms should have mulberry leaves to feed upon. They can also live on osage orange leaves. They will not eat any other than these two kinds of leaves unless they are just starving to death and then they may try to eat some other kinds, but they get along best on mulberry leaves.

A kind friend gave us some silkworm eggs. They were small—as small as little pinheads. They were in a round group, close together and sticking to a sheet of paper. There were about three hundred of them in one group.

We put the slip of paper with the eggs on it into a tray made of a paper box lid and watched them day by day. It was not long before some tiny



FIG. 19.—Silkworm eggs. A small portion of a large group. (Enlarged.)

little caterpillars hatched from some of the eggs. They were dark in color and covered with fine hairs. They were no bigger than this line -. We quickly put mulberry leaves in the tray with them. They seemed to have some way of knowing what the leaves were, for they went over to the leaves at once, and began eating them.

They were so very small that they could not eat much in a day, and as the leaves soon dry up, fresh ones are given once or twice each day.

After feasting this way for about four days each little caterpillar stopped eating and became very quiet. It seemed as if it were asleep for about a whole day and night.

Then the covering of its head came off. Its skin was loose from its body and out it crawled from the old skin covering. It was quite a bit bigger than it was and had on a fresh new skin.

This is the way all other kinds of caterpillars grow as well as the silkworm. The outside skin does not grow larger as does the body inside the skin. So the body soon gets too large for the old skin. The body forms a new skin over it just under the old skin. Then the old skin breaks and the caterpillar crawls out. This is called moulting.

Soon after the little fellow had moulted it seemed hungry and began eating heartily again on the mulberry leaves. It ate away this time for about five days more and then seemed to go to sleep again. It was getting ready for another moult. At the end of this moult it was bigger than ever.

It was large enough so that we could now see plainly its head and mouth and its legs. It had, near its head, three pairs of legs. At the back part of the body were four pairs of feet and at the very end was one pair. On these five pairs of feet



FIG. 20.—Silkworm on mulberry leaves nearly ready to spin its cocoon.

there are many very small sharp claws. With these it can hold to the leaf very firmly.

In about five more days there was another moult. The caterpillar was bigger than ever, and eating more and more.

Then in about five more days was the fourth moult. When the silkworm came out of this moult it was quite a large caterpillar. It was

from three to four inches long. This big silkworm was very hungry and ate all the time. We had to get many leaves for the large number of caterpillars we had and change the leaves three or four times a day. In watching one, you could see its jaws biting off the edges of the leaf. It quickly made a hole in a leaf and soon chewed up the whole leaf.

It kept up its lively eating for a week or more. Then it became quiet and seemed to sleep again. It crawled off a little way as if it were seeking a quiet place. It was getting ready to spin its silk bed or cocoon.

The mulberry leaves it had been eating were partly used in its body to make it grow and partly to make the stuff that forms the silk. Just as when a cow eats grass, some of the food it takes in is made into the flesh of its body and some is made into milk. So now this big silkworm is full grown and is ready to give out its silk.

SPINNING THE SILK

The worm now needed some quiet snug corner in which to spin its bed. The bed of a moth caterpillar is called a cocoon. Well, we made some cozy corners out of paste board and placed them about on the tray where the silkworms were ready to spin.

Soon one of them found one of these corners and we had the good fortune to see it begin its work and finish it. The very fine silk thread is spun from

two places called glands that are near its mouth. It first fastened the silk thread on one part of the paste-board corner. Then it carried it across to another place wide apart from the first place. Then it carried the silk thread to other points and fastened it all around until it had a loose net

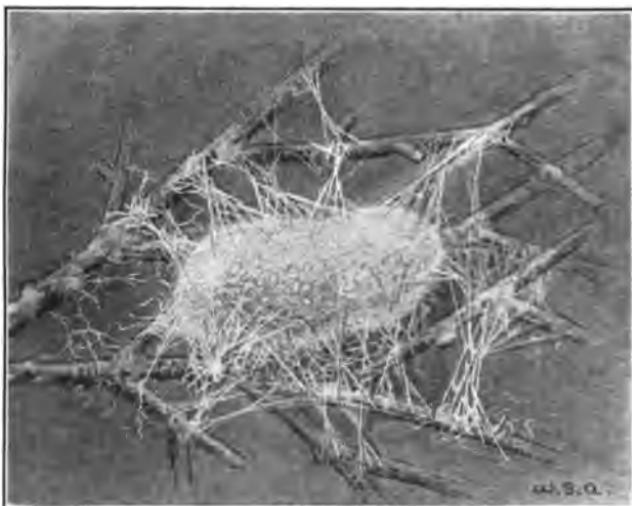


FIG. 21.—Silkworm cocoon.

work scattered across the corner. All the while it kept itself inside of this loose net.

Then it began to weave the silk thread round and round closer to its body until it had a beautiful veil-like curtain all about itself nicely hung in the loose net work of silk with which it had first filled the corner.

This delicate curtain was so thin that when we held the paste-board corner up to the light we

could see the worm plainly and watch it put the thread down and around it. Busily it kept up its weaving until the curtain covering about it got closer to its body and became thicker and thicker until we could no longer see the worm through it. Then it had its silken bed done where it was to sleep until it changed into a moth.

SILKWORM Cocoons

It was very interesting to see this little fellow working so hard and going through all its wonderful changes. We often thought of the great Chinese Queen who watched these same changes four thousand five hundred years ago and first thought how she could make use of them for human beings.

All of our silkworms made white cocoons. Sometimes they make yellow cocoons.

If the silkworm is well cared for and has a quiet place, the cocoon may be made of one unbroken thread. This has been known to be as much as a mile in length. It is often as much as a half a mile of unbroken thread.

The silkworm, like other caterpillars of moths, spins a cocoon as a bed in which to sleep while it changes to a moth. As a moth it lays its eggs. The eggs hatch out into caterpillars and in this way start the life over again.

But man, who wishes to get the finest silk for clothing, takes the cocoon before the moth cuts its way out. When a moth does get out the silk

thread is broken and can not be unwound in a very long single piece. To keep the cocoons from being cut by the moth they are heated so as to kill the little sleeper inside. The cocoons that are cut are not thrown away as people know how to get some silk out of them. The silk makers only save enough cocoons to bring out live moths enough to lay eggs for the next year's lot of silk-worms. As a mother moth will lay about three hundred eggs, people can use a great number of cocoons for silk and still have enough left to raise the next year's supply of eggs.

As we were not going to make silk, but wished only to watch how the little animal lives we kept the cocoons until the moths came out of them.

THE SILKWORM MOTH

In about a month after the cocoons were made, one day a moth came out of a hole it had cut in one end of the cocoon. Then another appeared from another cocoon. A little later the others came forth.

When a moth comes out of a cocoon its wings are wrinkled and damp. But they very soon dry and smooth out and become firm. The moth keeps fluttering them nearly all the time but it is never strong enough to fly.

Other kinds of wild moths are good fliers when their wings get dry. We often see them flying about the flowers in the evening, or they may come in the window at night and fly about our

lamp in a very lively manner. But the silkworm moths, for so many thousands of years have been cared for by people who brought their food to them, mated them, and cared for their eggs that they seem to have lost the strength to fly about as other kinds of moths do.

We mated our moths on clean sheets of paper and after a short time each of the mother moths

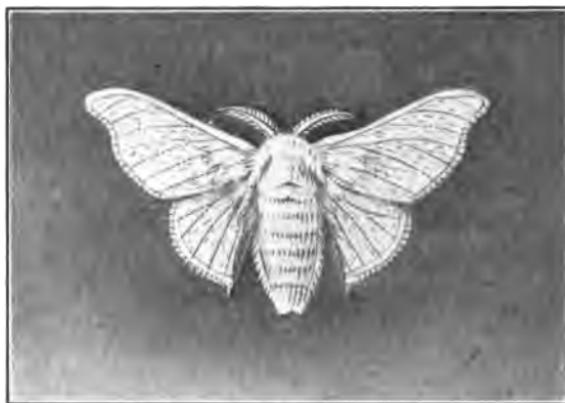


FIG. 22.—The silkworm moth.

laid a group of eggs which she glued fast to the paper.

Now we have a picture in our minds of the way the silkworm lives and makes the silk for all the world.

It is wonderful to think of the hundreds of thousands of people in the far away countries of China, Japan, India, France, Italy, Spain and England, and even in still other countries, every year, who raise the silkworms and cocoons and the

thousands and thousands of others who take the cocoons and unwind them and weave them into silk. To do this they make use of many small and many large machines and many large buildings.

The children in most of these countries help in taking care of the silkworms. How interesting it would be to visit these countries and see the children of different peoples at this work. When a girl puts on her silk hair ribbon or a boy his silk tie we may wonder if the silkworm was fed by a French, an Italian, a Turkish, a Chinese, a Japanese, a Persian or some other far away country child. When the child of a far away country, in its strange dress, and speaking a strange language, gathers mulberry leaves for the silkworms in his home, he does not dream that he is helping to produce silk for a ribbon for little girls away across the ocean in far off America.

A SMALL BUT VALUABLE FRIEND

*"Ladybird, Ladybird fly away home,
Your house is on fire and your children will burn."*

So sang Alice as she leaned over a little ladybird, as it was crawling across a rose leaf. Sure enough the ladybird quickly raised its wing covers and unfolded its filmy wings and flew away. But it was so quickly out of sight, that you couldn't tell

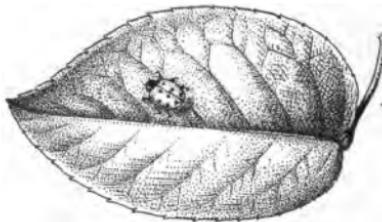


FIG. 23.—The ladybird.

if it went to its home. This old song to the ladybird has been sung by children in many countries and for many years. I suppose our grandmothers sang it to ladybirds when they were little girls, and, no doubt, their grandmothers sang it too. Some of them may have called them ladybugs and some ladybirds, but it is all the same, though ladybird sounds nicer.

Everybody knows the ladybird and likes it too and never thinks of harming it. It is so pretty

and innocent looking. But every one would like it still better if he only knew the very great good it does for us.

But how can such a little thing as this tiny beetle do any great good? Well, it often happens in this world that very little things can do a very great good or can do a very great harm. The little ladybird does us an immense amount of good by fighting some very little things that do an immense amount of harm.

There are a number of kinds of very small insects which fasten themselves tight to the stems or leaves or fruit of many kinds of trees. They fit so closely to the stems that they do not appear as insects or any thing alive. They look like little scales or scabs on the bark. For this reason they are called scale insects. They pierce down into the plant with a sharp beak and suck out the juices. Just a single one may have so many children that soon there may be thousands all over the bark, leaves and fruit. Although each scale is very small, the very great numbers take so much juice out that they make the plant weak and sick and spoil the fruit. They may get so bad that the plant dies.

The number of kinds of scale insects is so great, that there is one kind for almost every kind of plant. They are very harmful to the different kinds of fruit trees. If left alone they would spoil most of them and kill great numbers of them. The orchard man has to fight them all the time. Now

this is where the little ladybird comes in to do its great good. It helps rid the fruit trees of the ruinous scale insects.

The neatly dressed little ladybird looks very charming and innocent as she busies about over the stems and leaves. And she is so harmless to us. But the trim little lady is really a terror to the scale insects. She lives on their eggs and on the scales themselves. She knows how to hunt them out. Although the scale insects have clever ways of hiding their eggs and of making themselves look like any thing but a live insect, they can not deceive the ladybird.

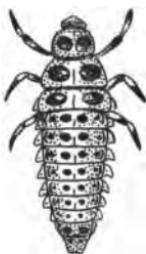


FIG. 24.—The larva of the ladybird. (Enlarged.)

The ladybird's children are just as destructive to the scale insects and their eggs as is the grown up mother. They do as much good for the orchard trees as the grown folks of the ladybird family.

Of course Alice wished to see some of the children she had been singing about. Well, they were very easily found, for they are as common as the grown ups. But when we found some on the plants, Alice could hardly believe such ugly little things belonged to such a tidy little mother. They are somewhat flat, and about half an inch long. The surface of the body is rough and hairy. It is dark with some reddish spots on its back. It has six legs and as it slowly crawls about it gives you a creepy feeling.

After searching through the garden and orchard we found a number of ladybirds, but they were not all alike. Their shape is very much the same, but they differ in size and color. Some are red, some black, some red with black spots on the wing covers. Some kinds are more common in one part of the country and some in another.

The different kinds of ladybirds live in much the same way. But some kinds like one sort of scale insect better than the others do. So you will probably find ladybirds on the plants that have their favorite scale. Different kinds of ladybirds have different ways of placing their eggs. Some hide them one by one on the plant. Others place them in little clusters near where the tiny young ones can find the scale insect food as soon as they are hatched. Of course the little children of the different kinds of ladybirds are also somewhat different, but they all look more or less like the one we found, whose picture is given here. You can see that it looks something like the aphis-lion and it is about as greedy in eating scale insects and plant lice, no matter where it finds them.

Like the caterpillars of butterflies and moths, the children hatched from the ladybird's eggs must change their skins as they grow. This changing of skin is called moulting. All insects grow in this way. The young that hatches from the egg of an insect is called a larva. The caterpillar is the larva



FIG. 25.—
Pupa of the
ladybird.
(Enlarged.)

of the moth or butterfly. The aphis-lion is the larva of the lacewinged fly. Thus it is said that the larva of the ladybird moults four times. Every time it moults, it is a little bigger and a little uglier and kills more scales than ever.

When it comes time for the larva period of life to end, it hangs by its tail and humps up into a sort of ball. This is something like the chrysalis of the butterfly. It is then called the pupa. There it awaits the change that goes on inside the ball, and when it comes out it is a complete little ladybird, fitted up with wings, covers, and all the other parts that make up this pretty little beetle.

Many interesting stories could be told to show how important some ladybirds become. In some parts of California there are many orange and lemon orchards. From them car loads of oranges and lemons are sent to all parts of the United States and other countries. Perhaps every boy and girl has eaten an orange or has drunk a glass of lemonade made with lemons from the orchards of California. Now there is a kind of scale insect that lives on orange and lemon trees. Its name is the cottony cushion-scale. It is given that name because its eggs are laid in bunches that look like little pieces of cotton, which lie under the scale like a cushion. This scale lives on other plants as well as orange trees. But it seems to like orange trees very much. One mother scale may lay as many as a thousand eggs. In the summer there may be several broods. Thus the increase in

number is very very fast, as you can see. When once the scale gets started on a tree the whole tree is soon covered with thousands, then the tree gets sick, the fruit spoils, and, at last the tree is killed.

Well, some years ago the cottony cushion-scale attacked the orange and lemon orchards of California and increased to such great numbers that



FIG. 26.



FIG. 27.

FIG. 26.—The cottony cushion-scale. The fluted part looks like cotton and is filled with its eggs.

FIG. 27.—The Vedalia. The great fighter of the cottony cushion-scale. (Enlarged.)

people thought all their orange orchards would be destroyed. They did every thing they could to kill off the scale insects but they came on too fast for them. Finally a gentleman by the name of Mr. Albert Koebele went to the far away country of Australia, and there found a tiny ladybird which eats only cottony cushion-scale eggs. He caught a number of these and brought them on the long trip across the great Pacific Ocean to California. He set them free in a California orange orchard.

Then the great fight began. A few spunky little

ladybirds against the millions of cottony cushion-scales that were eating up the thousands of orange and lemon orchards of the state! This little Australian ladybird lays many eggs and raises children very fast herself. The children, the larvæ, are great eaters of cottony cushion-scale eggs as well as are their mothers. They both worked hard eating eggs, the mothers rearing more and more children till at last they checked the increase of the scale and the orange orchards are safe. One name for this ladybird is the Vedalia, which is rather a pretty name. A picture is given of it. The color is red with black markings. It has a fuzz of fine hairs over its back. All the orange men in California know about this little friend and think it is worth many times its weight in gold.

There are other enemies of the cottony cushion-scale. In addition the orchard men keep fighting this scale and other insect enemies with poison gas and sprays of poisonous liquids, but they believe the little Australian Vedalia ladybird was the real savior of the orange orchards. They trust to the Vedalia to keep them safe. Whenever a boy or girl gets a big California orange to eat, he may thank the little friend that Professor Koebele brought from the other side of the world.

Professor Koebele found another ladybird which he brought to the orange orchards and let loose at the cottony cushion-scale. This one helps the Vedalia fight the scale and is an immense help.

This one has been named the Koebele ladybird, to honor the man whose eyes were sharp enough to find these great cottony cushion-scale fighters.

Many other interesting stories could be told of other kinds of ladybirds and their fights against many kinds of scale insects and plant lice to save our fruit trees and other plants that we value highly.

I once saw an interesting sight that astonished me greatly. One winter day I was tramping in



FIG. 28.



FIG. 29.

FIG. 28.—The Koebele ladybird, another great enemy of the cottony cushion-scale. (Enlarged.)

FIG. 29.—A common kind of ladybird. This is the kind that sometimes gathers in great numbers in California in winter. (Enlarged.)

the foot hills of Black Mountain near Stanford University in California. In a deep canyon filled with a growth of trees and ferns, I came upon a large stump that had a reddish color. On examining it more closely, I found it covered with thousands of ladybirds, piled up several inches deep. They not only covered one side of the stump, but a thick layer of them was stretched out on the ground, at the bottom of the stump.

Near this was a great log. One side of it was also covered with ladybirds. If they had all been gathered up there would have been several gallons of them.

Later I learned that in the mountains of California, such great gatherings of ladybirds have been found in various places every winter. In some other parts of the United States, it is said that bunches of ladybirds have been found in winter time, although not in such large numbers as those sometimes seen in the mountains of California. It is said that in the spring, the ladybirds leave their companies and scatter to the valleys where they can find scale insects and plant-lice. They were just here spending the winter together.

But why they select those places, and how they select them and find them and how they tell one another about it so that they can get together is a mystery that has not yet been solved.

Not all ladybirds spend their winters in great companies. Some hide in cracks and crevices and in other sheltered places, either by themselves or a few together where they remain quietly, until the winter is over. When Spring comes, they come out and fly forth to find their hunting grounds and raise their great broods of homely but hard working children, to carry on the great summer fight against plant lice and scale insects.

A SKILFUL MASON

One September day in looking through an old trunk that had been stored in the attic, I came upon a shirt that had a large piece of dried mud sticking fast to it. That certainly looked like a strange place for mud to be. I peeled it off and took it down to show the children. "Oh, that is a



FIG. 30.—A mud-dauber wasp's nest.

mud-dauber's nest," cried Andrew, "I have seen lots of them sticking to the rafters of the barn. They are made by wasps." "What do you think is in this one?" I asked. "I don't know. I never opened one but I suppose young wasps and I don't care to open one" said he.

Then I proposed to open it for them and take the risk of getting stung. So they gathered around the table to get a good look. I carefully cut away

the hard mud from one side and found a little tube about an inch long. The children watched intently but were ready to dodge if a wasp flew out. But no wasp flew out. Instead out rolled a half dozen little things. "Spiders" called out Ella.



FIG. 31.—A mud-dauber's nest opened showing the spiders taken out of it.

And sure enough they were spiders and not all of the same kind.

They were examined again and again, and then came the questions: How could spiders get into such a place? What were they doing there? Arthur was sure he had seen wasps carrying mud and making the nests so spiders could not have made it. Any way, he said, the spiders were dead.

Andrew had been turning the spiders over with a straw when he said "I don't believe they are dead. They act as if they are asleep." He argued that a dead spider would be all dried up and its legs drawn up to its body. But the legs of these spiders fell about as if their owners were asleep or dazed.

Then Arthur touched one with a stick and was sure it moved a little. Then they all tried it and found that, true enough, some of them moved just a little bit. It all seemed quite a mystery.

While Ella was examining them, she cried "What is this little thing hanging to one of the spiders?" All eyes were then turned toward this spider and it was seen that the little thing hanging to it was a tiny grub that was eating the spider.

People who have watched very carefully the mud-dauber at work give us the true explanation of the mystery.

The wasp gathers little balls of mud and with the skill of a master mason, patiently builds a tube such as we had before us. Before she puts the cap on, she goes hunting for spiders. The spiders which live by pouncing on insects are pounced on in turn by this clever little wasp. She stings the spider just enough to benumb it but not kill it and stores it in the tube.



FIG. 32.—The kind of wasp that made the nests.

She keeps on doing this until the tube is full of spiders and then she lays an egg. Then she puts a cap over the tube. When the wasp's egg hatches into a little grub, it has enough spiders stored with it to last it as food until it grows large enough to almost fill the tube. Then like many insects it makes a cocoon and lies asleep through the winter, until it is ready to come out as a full grown wasp in the spring.

When this change takes place the new wasp cuts a hole in the end of the tube and crawls out, and is ready to fly about and start in making a mud nest of its own.

Now to look again at the nest. There was more than one tube. The mother wasp makes one and fills it, then she goes to work on another, and plasters it to the side of the first one. This is stored with spiders and one egg is laid on one of the spiders and the tube is sealed up. Then others are built. When she has a number finished she plasters them over with mud so that the whole group looks like one lump of dried mud.

There are very many kinds of mud-daubers and they do not all finish their nests in just the same way. So if you find one, it may be a little different from the one the children saw but still they are all very much alike. Afterward a number of nests were opened and it was found that some of them were filled with only one kind of spider while other nests were stored with different kinds in the same nest. The number of spiders in the

nests were not the same for the different nests. The largest number found in one nest was twenty five.

These wasps differ from most other wasps by having very long slender waists. That is, the hinder part of the body is joined to that part which bears the wings by a very slender, long stem, which we might call the waist. The picture was made from a wasp caught building one of the nests.

Is it quite fair to call them mud-daubers? They do not daub the mud about, but build very skilfully the neatly made tube, just the right size for the body of the cocoon. They skilfully make the outside look like a rough daub of mud, no doubt to deceive some animal looking for the wasp's grubs to eat.

Then although they work in the mud, they do it very daintily and do not smear themselves with it. Sometimes children are seen making mud pies and they get the mud on their hands, faces and clothes and do not even make pretty shaped pies. They might well be called "mud-daubers." But the wasps should be called masons from their workman-like way of doing things.

Arthur thought, and we all agreed with him, that the most wonderful thing about this wasp was the power and skill of stupefying the spiders so that they would continue to live, yet be helpless for so long a time. If the spiders died they would dry up and not be fit for food. If they were put into the tube alive but not made helpless, the

savage creatures would eat up the little grubs, instead of the grubs eating them.

Well, we are not the only ones to consider this a wonderful thing. Scientific students of insects, think it one of the most wonderful facts in nature, that an insect should have such a remarkable poison and know just in what part of the spider's body to place it, and just how to put it there to benumb the spider, but not kill it. There are some other kinds of wasps that have this way of preserving the creatures they catch for food for their grubs.

Man has tried many ways to preserve the plants and animals he wishes to store away for food. The Indians used to cut the flesh of the deer they had killed, into strips and dry them. This has been called jerked venison and it may be kept a long time.

In countries where they have cold winters, people sometimes kill their chickens, pigs and sheep and freeze them. They would in this way be good as long as it was cold enough to keep the meat frozen. Some people keep their turnips, beets and cabbages by putting them in cellars that are cool, but not cold enough to freeze.

Nowadays, great warehouses are built which can be made very cold like a big refrigerator. They are called cold storage houses. Into these, various kinds of meats, eggs, fruit and vegetables can be kept until they are needed.

Then again great quantities of fruit and vege-

tables, as well as meats, are canned or dried. These are the inventions of man. But long before man ever invented these ways, the mud wasps had found a way that man does not understand well enough to copy. I hope human beings will never learn that way for it seems to me to be a cruel one.

THE MILKWEED BUTTERFLY

A TREE BLOSSOMING WITH BUTTERFLIES

A pine tree has many charms for us. It stands up straight and stretches out its arms loaded with tufts of needle leaves and cones of seeds. With a great army of its fellows, it makes a noble forest

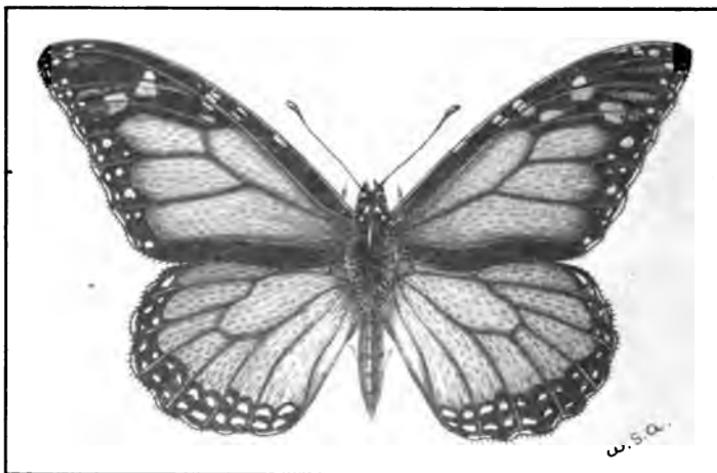


FIG. 33.—The milkweed butterfly. The Monarch.

which covers the hills and mountains with a dark green mantle. In its depths many a bird and beast and insect finds its home. A path that winds through a pine forest leads you to a thousand interesting sights and sounds.

But as much as we love a pine tree, we can hardly claim for it that it is a bright object. No, it is quite a sober looking tree, except sometimes, when the rising sun may light up the dew-drops hanging to its needles, or when the rays of the setting sun may, just after a shower of rain, make brilliant the drops of water still clinging to the tips of the pine needles.

But once, while strolling along a path in the pine woods near Pacific Grove, on Monterey Bay, California, I saw a pine tree gay with bright colors. It looked as if it had burst into the bloom of a thousand bright flowers. I was filled with astonishment at the sight and quickly went nearer to find out what wonderful thing had happened to the sober-colored pine tree to paint it up so gorgeously.

On coming near, the mystery was solved. There were hanging from the branches and needles thousands of large, brightly colored butterflies. The mystery of the color of the pine tree was explained, but there was another mystery. That was, where did this great company of brilliant creatures come from, and why did they gather together here in such vast numbers?

It was an easy thing to catch these butterflies. It was just like picking peaches from a peach tree. All you had to do was to take them off with your fingers. They were hanging quietly as if taking a rest after a long journey to this meeting place. Here is a picture made from one of the visitors to this butterfly convention.

THE LIFE OF THE MILKWEED BUTTERFLY

This butterfly is called by several names. The most common are the *Milkweed Butterfly* and the *Monarch Butterfly*. In the scientific books about it, it has the name *Anosia plexippus* which for some reasons is a useful name and Anosia at least has a pleasant sound. But milkweed butterfly is a good name and easy to remember. It is called that because it always lays its eggs on some kind of milkweed where they hatch into caterpillars which feed on the leaves.

The milkweed butterfly is very beautiful and it is quite large. The one in the picture was four inches from tip to tip of its front wings, but some are as much as five inches across. The upper side of the body is black with some small white dots on the front part. The borders of the wings and the lines on the wings are black. The spaces between the lines are dark orange. There is a double row of white dots on the margins of the wings. The underside of the wings is about the same as the upper only the orange spaces are of a lighter shade, and there are rows of white dots on the body.

This beautiful butterfly may be found all over the United States during the summer time. Wherever there is some kind of milkweed on which to raise its children we may look for the milkweed butterfly. As the butterfly does not eat the leaves of the milkweed but sips the nectar of many kinds of flowers as its only food, it flies

over the gardens and fields and along the edges of the woods, low down in the valley and high up in the mountain, wherever flowers are found.

It visits so many places and is so large and showy, that those who look for butterflies are pretty sure to find this one in their rambles. It is a beautiful sight to see it flying. It has a small light body and such large wings that its flight is easy and graceful. It does not have to flutter or violently flap its wings but softly fans the air or glides smoothly along by sailing. When it wishes to do so it can make a strong flight. If a wind springs up it may veer right into it and fly bravely against it, sometimes rising as high as the tree tops. We know that it can fly long distances as it has been seen flying along by people on ships more than one thousand miles from land. It is hard to understand how such a light frail thing can show so much strength and courage as to face a storm or to venture so far in its flight. Because it does so it is called the Monarch and makes every one admire it.

Dressed up so gaily, sailing about, sipping nectar from beautiful flowers, opening and shutting its gaudy wings to show them off or resting on the soft petals of some bright bloom, you might think this beautiful thing very lazy and frivolous. But it has its very important work to do and if it did not do it there would be no milkweed butterflies in a year or so.

It must find a milkweed and lay eggs on it. It

must be careful and make no mistake and get its eggs on any other plant, for if it did, when the little caterpillars hatched out, they would starve to death.

How does the mother butterfly know milkweed from other plants? She has fed on nothing but nectar of flowers all her butterfly life and could not bite into a milkweed leaf to taste if it she wished to do so. That is a hard question to answer. Perhaps she remembers back to the time when she was a caterpillar and feasted herself on milkweed. Perhaps she got so much smell and taste and feel of milkweed in those days of feasting on it, that she can't forget it and can still tell milkweed from all other plants. At any rate she has some way of telling, and it is a very good way, for she has never been known to make any mistake about it.

When she finds a milkweed, her next work is to fasten one egg to it, usually on the underside of a leaf. As you might expect, from one with such charming manners and dresses, she is very delicate and neat in her work. The egg is not as large as a pin head. But if you look at it with a magnifying glass you will see that it is a very beautifully shaped object. It is like a cone-shaped piece of jewelry carved with many fine delicate lines which are arranged in a very neat pattern.

She may place more than one egg on this plant, but not many, for two or three caterpillars are about all that can get enough food to live on out of one plant, as they are quite large when grown

and they are very hungry people. She then flies to another milkweed and then on and on to many places far apart.

THE CATERPILLAR'S LIFE ON ITS MILKWEED HOME

The life of this milkweed caterpillar is like the life of all butterfly caterpillars. If you could find one of these caterpillars it would be a very interesting sight to watch its ways of living and growth. In seeing the life of this little animal from the egg to the butterfly, you learn the way by which every other kind of butterfly becomes the beautiful visitor of flowers that it is. They differ in that each kind picks out its own kinds of plants for its caterpillars to live on.

A box or a glass fruit jar with a cover on it will do for a cage to keep the caterpillar in. Or you might make a cage like some of those shown in books about insects. When a caterpillar is found, it is placed in the cage with some milkweed leaves. Then every day give it some fresh pieces of the stems of milkweed with leaves on it. If you are lucky enough to find an egg, so much the better, for then you may have the good fortune to see the very beginning of the story.

Four or five days after an egg is laid, it hatches into a tiny caterpillar. The first thing this little fellow does is to eat up its own egg shell. It has its reasons for such a breakfast but it has never told me what they are. After that it is milkweed, and always milkweed, without even trying what

the other kinds of leaves taste like. That is the way it is with some other kinds of caterpillars.



FIG. 34.—Caterpillar of the milkweed butterfly.

They live on only one kind of leaf all their days. While still some other kinds will eat every kind of green leaf they can get.

This little caterpillar's work is to eat and grow as big as it can. When full grown it is almost two inches long and is fat and roly-poly. Now there is one thing about a caterpillar that causes it a little trouble once in a while as it gets bigger, and that is its skin, which is a thin hard covering that will not stretch. Now, as the caterpillar grows, the skin gets very tight and must be got rid of if the animal is to be any bigger. Nature, however, has arranged for all this very nicely. Every few days a new skin grows over the body just under the old skin and loosens the old skin, which breaks and lets the caterpillar come out with a clean new suit of clothes on and ready for another time of feasting.

Caterpillars and butterflies do not breathe through their mouths nor do they have lungs. Along the side of our caterpillar you can see, plainly, a row of eight dots. Looking very closely you will find that these are curious little openings into the body. They are the breathing holes of the animal. They are called spiracles. Each one is the opening of a tube that divides into smaller tubes that spread out into all parts of the body. The air is taken in by these spiracles and goes through the air tubes to every little part of the body. Every movement of the body causes the air to move in and out the spiracles. Not only caterpillars but all kinds of insects breathe in this way.

The shedding the old skin is called moulting. The milkweed caterpillar goes through this change

four times before it attains its full growth. It is said to have four moults. If you have a caterpillar in a cage, you will be sure to see one or more of the moultings. When it feels one of these changes coming on, it finds what it thinks is a good place on a leaf and spins a silk rug, which it glues fast to the leaf. This rug is just the thing for the hundreds of fine sharp hooks of its back feet to fasten into. Then it takes its place on the rug, fastens its hind feet into it and quietly waits for something to happen.

It will stay perfectly still in this way for a long time and then perhaps after a whole day it begins to make motions with its body from side to side and in other ways, still holding tightly to the silk rug. These movements get the new skin loose from the old skin. First the head is drawn back from the old head covering. Then the old skin splits just behind the head covering and that gives the caterpillar its chance to crawl out of its old skin which it gets rid of by making many movements of its body, as if it were a great deal of hard work. After it is over, the head covering lies in one piece and the old skin of the rest of the body shrinks up very small. The caterpillar with its new soft skin then rests quietly awhile, waiting for the new skin to get firmer so that it can move about more safely.

Then strange to say, it turns about and eats up the old skin before it begins on the milkweed leaf again. That does not look like a nice thing to do,

but it must be all right for caterpillars, or they wouldn't do it. All this can be seen best in the last moult when the worm is large and the parts more easily seen.

The caterpillar, when it is first hatched out is not so brightly colored as it gets to be later. But as it becomes larger it is quite a beautiful object. When grown, it is nearly two inches long and has bright black, yellow, and green stripes running crosswise over the body, which are so plain that the caterpillar is easily seen on the plant while feeding.

There are two long black thread-like horns rising up just a short distance behind the head. These wave back and forth as it crawls. There are two smaller ones near the tail end of the body. They give the caterpillar an important look. Perhaps the horns are thought by them to be stylish, like feathers in a cap. It has very strong jaws for biting off and crushing mouthfuls of the leaf. And at the mouth is a tiny spinning machine from which silk is spun when it makes its silk rug to fasten to when it moults.

Just back of the head are three pairs of jointed legs, each ending with little claws. It uses them just as if they were hands with fingers. They hold the leaf to the mouth with them and also use them to handle the thread of silk. These six legs grow into the six legs of the butterfly later.

Besides these six jointed legs it has five pairs of very short ones without joints on the back part of the body. One pair is at the very hind tip of the

body. These are short stubs more like mere feet than legs. They are little knobs of skin furnished with rows of hundreds of very fine little hooks which they can fasten into or loosen from the rough surface of the leaf or the silk rug which they spin. If you let the caterpillar crawl on your hand, it can hold on to your skin by these feet, the hooks of which you can feel as tiny scratchings.

These five pairs of unjointed feet are for use while it is a caterpillar and are lost when it changes into a butterfly. They are so very useful to the caterpillar, that it could not get along without them. It uses them to crawl safely on both the upper and under side of the leaf. Then it must have them in moulting, to hold firmly to the silk rug. Of course the surface over which it crawls, has to be a little rough for it to fasten the hooks in. If it comes to a smooth place on the plant's stem, or if it had to climb up a piece of glass, it has to stop until it spins up a pathway of silk which it glues fast to the smooth surface. It can then walk up this pathway because its feet with the hooks can lay hold on the silk. This makes the crawling up the side of a glass jar very slow work, but there is no other way to do it.

Since milkweed caterpillars are so clearly marked with gay stripes of bright colors and sit in plain view on top of their milkweed towers, you would think that the caterpillar eating birds would not leave one of them alive. But for some reason the birds do not seem to like this kind of caterpillar

very well. Perhaps they have a smell or taste not pleasant to the birds. At any rate the birds let them pretty well alone.

But they do not have such good luck with some kinds of insects, especially when they are little. Then spiders and crickets and other insects pounce upon them. There are too, certain kinds of insects that have a horrible way of alighting on the backs of caterpillars and stabbing a hole in them and laying their eggs right in the caterpillar's body. These eggs hatch out in the caterpillar's body as tiny larvæ that gradually eat the poor caterpillar alive.

When our milkweed caterpillar gets scared by rough handling it tries the trick many insects and some other animals know. That is of pretending to be dead. It will roll itself into a ball and drop down into the grass and keep perfectly still for quite a while. This is a pretty good trick for it is certainly hard to find this lifeless little thing among the trash on the ground.

If our caterpillar escapes all its enemies it must be a happy life that it leads, dressed in gay colors, with plenty of nice juicy cream of milkweed to eat and riding on the top of its pretty plant as it "nods and bends in the breezes." But a short time after the fourth moult the caterpillar part of its life must come to an end and it must get ready to become a butterfly.

To pass from a crawling worm-like animal, gorging itself with milkweed leaves to a big beauti-

ful butterfly, that can fly fast and far and feed on the nectar of flowers, requires such great changes that you would think them impossible if you did not see them happen.

THE CHRYSALIS

That the caterpillar may grow into a butterfly, it first changes to what is called a chrysalis. In the stories of the silkworm and the tent-caterpillar it was seen that the caterpillar wove about itself a room of silk called a cocoon in which to lie while the changes went on that made it into a moth.



FIG. 35.—Chrysalis of the milkweed butterfly.

Most moth caterpillars weave silk cocoons, but most butterfly caterpillars do without the silk curtains and hang as a chrysalis from a limb of a tree or a leaf or other solid support.

If you should find a chrysalis of the milkweed butterfly, without knowing about it, you would never guess that it had any thing to do with

either the caterpillar or the butterfly. But if you have the caterpillar in a cage you can, by watching the changes, prove the truth. The chrysalis is found as a little barrel-shaped thing, a little more than an inch long and about half an inch through. It hangs by a slender black stem ending in many little hooks caught in a minute button of silk,

fastened to the support. And you would not find any thing in a jewelry store more beautiful.

It is more beautiful than any watch charm or locket. It is a delightful green with golden dots. Around about its middle is a row of tiny knobs in a band of black and yellow. How our caterpillar makes this astonishingly fine covering and manages to hang it so neatly to a stick is something that cannot well be told but better to be seen and wondered about. Of course it has to moult again to do it.

For this moult it gets ready by leaving the milkweed and crawling away some distance to look for a good quiet place where it hopes it will not be disturbed, and where there is something on which to hang the chrysalis. On the stick or fence rail which it has chosen, it first spins a little knob or button of silk. In this it fastens the hooks of the pair of feet at its very tail end and hangs head downward. Now it is ready to get rid of its caterpillar skin and come out with its new and charming chrysalis covering.

As you watch it, it does not seem at all an easy thing to do. But by many movements and splitting of the old skin and wriggling out of the old shell, it finally gets over the difficult task. It manages, too, to slip out the little black rod with hooks on the end and fasten the hooks in the button of silk that the feet of the old skin held on by. Now it is good bye to the old skin and instead there is a brilliant new chrysalis hanging like a

jeweled lantern or chamber, which will open before long to let a butterfly come out.

The chrysalis is so still and rigid that you might think the caterpillar had died and this was its coffin. Perhaps you have seen pictures of the coffins that the ancient Egyptians used for their mummies that were found in the great Pyramids, where they were placed thousands of years ago. Or you may have seen the coffins in museums. Their surfaces were painted with many colors. But this quiet beautifully colored chrysalis is no coffin with the body of a dead caterpillar in it. The little animal in it is very much alive and is, in its way, hard at work.

There is going on in its body, silently, a wonderful work. All the beautiful and curious parts of a large and charming butterfly are being finished in this pretty house. There is nothing more wonderful than the things that go on inside of the exquisite chrysalis hanging to an old fence rail.

THE COMING OUT OF THE BUTTERFLY

When the caterpillar went into this decorated covering, it already had started to form itself into a butterfly. In its body were tiny little beginnings, we might call them buds, some of which grew into wings, some into the eyes, the legs, the curiously formed tongue and, indeed all the other parts of the full grown butterfly. Put a caterpillar by the side of a butterfly. How different they look! The changes that made one

into the other went on inside of the jeweled case of the chrysalis. In fairy stories we read that a fairy may change one thing into another by the touch of her magic wand. Is there any thing more magical than the making a butterfly out of a caterpillar?

The butterfly at first is very much cramped in the chrysalis case. It's coming out is really moulting once more. As in the other moults, the covering of the chrysalis, which is the old skin, splits and slowly out comes the butterfly with the beautifully colored new skin covering wings, body and legs.

At first our butterfly is very soft and pamp and weak. It hangs by its claws to the first thing it can catch hold of, not yet able to fly. Its wings are at first short and thick and wet. But they gradually stretch out to their full size and become thin and dry. The covering of the rest of the body also becomes more firm.

In one way the new skin of the wings is wonderfully different from the skin of either caterpillar or chrysalis. It is covered with what looks like dust, which rubs off on your fingers if you touch it. If you see this dust under a microscope you will find that it is made of beautifully shaped scales, which cover the wings. They are all attached in rows. One row overlaps the one below it like shingles on a house. They are of beautiful colors and of many fantastic shapes. The butterfly works away, carefully fitting together two long pieces that are to be its tube-like tongue. When that is

done the tongue is coiled up in a spiral, like a watch spring, and tucked up neatly under its head. It is now ready to unroll and thrust down into a flower to pump out the nectar.

Now that it can move its feelers, its long tongue, its legs and its beautiful wings, it is fully ready to go forth on its life of egg-laying, nectar sipping and travel far and wide. No more troublesome moult-ing. It has become perfect and remains so the rest of its life.

THE MONARCH'S MIGRATIONS

Those who have watched the milkweed butterfly for years tell us that the birds seem to let it pretty much alone. Like its caterpillar, it seems to have a taste and smell that birds do not like. Now, as many birds are quite fond of most butterflies, it is a fine thing for our monarch to be left alone by them. We already know what a splendid flier it is. Since some kind of milkweed is found in most parts of the United States and in many other countries, there is always plenty of food. This, and the fact that it is not molested by birds, as well as its power of flight, gives the monarch much better chances of living than most butterflies get. These are the reasons its kingdom is so large.

When we started to learn about this butterfly you remember that we were surprised to find a great company of thousands, clinging to a pine tree near Monterey Bay, on the coast of California. It was learned later that about the same time in the

fall, there were gatherings like this in places as far away as in New England and other places on the Atlantic coast, also in other parts of the United States. Some of these gatherings were much larger than the one I saw. Some think that in this way they are getting together to journey south, as many kinds of birds do before the winter comes on. Such a journey is called migration. There does seem to be proof that the milkweed butterflies of the northern parts of the United States, do fly to the Southern States just before winter. Still it is a great puzzle as to why they should get together in such great numbers on their way. Then how do they get word to each other over such wide distances telling where the meeting place is? How do they plan their movements? How do they know the way south?

In parts of the country where crows live in numbers, we know they sometimes gather in a great company before going south. But they are very intelligent birds and can shout and chatter so loud and so much, it is easier to guess how they might do it. But it is certainly a mystery how this mild, quiet little butterfly manages it. The other kinds of butterflies have not yet learned to have such great conventions.

STUDYING BUTTERFLIES

No doubt you have many questions in mind about our butterfly, which are not answered in this story. Perhaps you may answer some of

these yourself by trying to watch some of the many kinds of butterflies about the woods and fields of your home. Or you may get eggs or caterpillars and raise some butterflies in cages for yourselves.

This story has been about one butterfly, the milkweed butterfly or monarch. It was chosen because it may be found in most places in the United States and most likely near to your home. But all butterflies go through about the same program of life. That is: egg, caterpillar, chrysalis, and butterfly. The eggs of the different kinds are of different sizes and shapes and are laid in different kinds of places. The caterpillars of the different kinds feed on plants of their own particular tastes. The chrysalis of each kind has its own particular size, shape and color and its own kind of hiding place.

The butterflies also differ in form and habits of life. But any one of them is a very interesting little animal and can be watched in about the same way as we have watched the monarch in this story.

The beauty of butterflies has given pleasure to many people even in olden times. Their charming dress and interesting ways have led many persons to explore our own country and many far away lands in quest of them. So there are many beautiful books written about them. People have traveled far to find the many kinds and learn their ways. You may see in museums fine collections of

them brought from many foreign countries. So if you get interested in butterflies you can easily find much help from the books and collections. Thus the watching and study of one butterfly like our Milkweed Butterfly, may lead you to learn much of many countries beside our own. Your thoughts, may, like the butterflies, fly to many strange and beautiful regions to get pleasure from them.

THE TOMATO-WORM

It was a beautiful bright warm summer morning. The garden was a delight, for the plants were green and healthy and growing fine. Mary stepped down from the kitchen and went through the garden gate with her basket, on her way to gather some beans, cucumbers and tomatoes for our dinner. I don't blame her for going slowly past the flower beds where the bees, wasps and butterflies were buzzing and fluttering over the flowers, gathering their delicious dinner ready prepared for them. It was set out in hundreds of beautifully shaped and beautifully colored cups and saucers and dishes. These were finer than are ever seen on a table full of china and silver sets.

Then all at once, Mary remembered how hungry we soon would be and hurried on. But in a minute she came rushing back, her eyes wide open with excitement. "What's the matter?" cried Tom. "You'll just have to go without tomatoes before you catch me in that tomato patch again," she answered quickly. "Why, what has happened?" asked Bessie. "When I stooped down to pick a tomato, there sitting up on the vine were three big green worms, that looked like dragons. Each had a big horn on its tail and it raised up on its hind feet and shook its head and

snapped its jaws. It looked like it was saying, 'You just dare to touch me and I'll hurt you.'" Mary was surely in earnest. Dragons! Well that word excited Tom and Bessie and, of course, they were impatient to see them. But I noticed



FIG. 36.—The tomato-worm. The caterpillar of the humming-bird moth.

they held back a little and turned to me to know if I would not show them the monsters, as it was quite plain that Mary was not going to do it.

I said I would gladly go and that there was nothing to be afraid of, for I knew pretty well that if the dragons were on the tomato plants, they were just some old friends that were up to their old tricks of making a big bluff.

We were soon searching the tomato vines. At first we could see no signs of the frightful beings that had caused Mary to beat such a quick retreat. But soon we found them, crawling on one of the top branches of a tomato vine. They were just nothing but three big tomato-worms. They are perfectly harmless, except to tomato leaves but these they do gobble down pretty fast. But for all that they certainly did look quite fierce, and Mary was not to be blamed for being afraid of them before she understood them. While they were surely big for worms, they were rather small for dragons.

The largest of the three was nearly four inches long. Its body was big and fat. It was a bright green with seven white stripes running obliquely on its side. There was a brightly colored spot on each breathing hole or spiracle. The color was so much like the tomato leaves, that it is no wonder we did not see the worms at first. It was quite true what Mary had said; each one had a large horn rising from its tail. It was sharp and looked as if it might be a big sting. Some people think that the worm does use it as a sting, and that it is very poisonous. But that is a great mistake. It is harmless and the caterpillar does not seem to use the horn for anything at all.

When we shook the vine or touched the worms, they did as Mary had said. They raised their heads and front part of the body, high, shook their bodies and made a little snapping noise with their jaws.

They acted as if they were trying to frighten you away. But when you know that they will not, and can not, do you any harm, you feel like laughing at their pretending. Whenever they quieted down the children thought it great fun to stir them up again.

The next question was where did these monster caterpillars come from? And as we had learned from the silkworm and the milkweed caterpillars that caterpillars in time change to either moths or butterflies, the children were anxious to find out what the tomato-worm would change into.

Tom made a cage like the one we had put the milkweed caterpillars in. I suggested that he put three or four inches of moist dirt in the bottom, for this kind of caterpillar would need it later. So the three were taken to their new home and every day were given fresh tomato stems with leaves on them.

These caterpillars were full grown so we did not have to feed them many days before they showed signs that they had eaten tomato leaves long enough and that their caterpillar days were about over.

They crawled down from the tomato stems and began to dig holes in the earth and soon buried themselves out of sight. "Well," said Bessie, "that is a strange thing for a caterpillar to do. I think it much nicer to spin a cocoon like the silkworm or hang up a beautiful chrysalis in a hidden place like a milkweed caterpillar." They did not

like the idea of not seeing what was going on. They wanted to know how long they would have to wait to see what would come out of the ground. They were much disappointed when told they would have to wait till the next spring. Then they put the cage away in a safe place for the long delay.

Two or three weeks after this, Tom said to us,



FIG. 37.—
Chrysalis of the
hummingbird
moth.

"Couldn't we dig down just to see what has happened to one of those tomato-worms? We can put back what we find just the same as we find it and maybe it will be all right for next spring."

That seemed to be a very good idea.

So out came the cage and he very carefully dug down, where one of the caterpillars had hidden. And this is what he found buried in the dirt. A little brown jug, something more than two inches long, with a handle on one side. When looked at more closely the little jug was seen plainly to be a sort of chrysalis. Through the hard brown skin you could see the divisions of the body at the tail end. Then at the head end were the parts that are to be wings and eyes and the jug handle was to be the tongue. This brown chrysalis showed itself to be alive by a slight movement of the tail end whenever it was touched.

Well, we felt well repaid in seeing this curious

object. While it was not a beautiful chrysalis like that of the milkweed caterpillar, still it was a chrysalis all the same.

The tomato-worm had learned to hide its chrysalis out of sight and where it would be protected from the cold of the winter. Tom put it back very carefully and the children were now more contented to wait for the outcome of this homely but interesting chrysalis.

THE HUMMING-BIRD MOTH

A few evenings later we were sitting on the steps of the porch looking over the garden. The sun had set and it was just becoming dusk. We were watching the big yellow evening primroses popping out. As a new one would flash out its golden

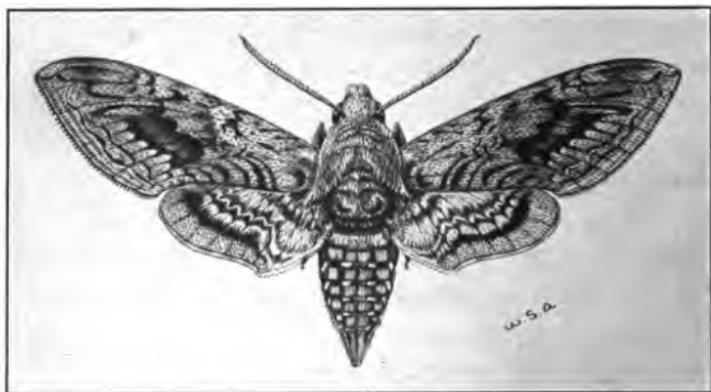


FIG. 38.—The humming-bird moth.

petals, one of the children would shout "There's one," and "There went two," and "There's another." They were opening so fast we could hardly keep count. "There's a humming-bird," called out Bessie. Tom said "Why, how's that? I thought humming-birds did not come around this late in the evening." Well of course this was something that needed looking into. So we

quietly slipped along the flower beds to get a good look at whatever it was, whirling so rapidly up and down and around among the flowers. It certainly acted just like a humming-bird and seemed about as big. But as it whizzed past close enough to be seen better, it was shown to be no humming-bird but a magnificent big moth.

It flew by like a shot until it stopped at a flower to get nectar. Then it did not alight on the flower as butterflies do, but hovered in front of it with rapidly whirring wings, just as a humming-bird does. It very quickly unrolled a wonderfully long tongue, which quivering with vibration, was thrust, like a dark streak, down the tube of the primrose to pump out the syrup. Then, in an instant, the moth whirred to another flower and then to another. That tongue was surely a marvel. It must have been all of four inches long and it managed it with a quickness and skill that astonished us.

That tongue could reach the bottom of the flowers that have deep tubes in them and the moth still remain far enough away to hover with whirring wings in front of the flowers without touching them. It tried our honeysuckles and primroses in the flower beds and visited the "jimson" weeds along the road. It got its sweet drink in the same way that children suck up icecream soda with a long straw out of a deep glass. More than one came to our garden that evening, and we tried to catch one. But they took

fright so easily and flew so rapidly and with such great strength, that it was only after hard work that we finally caught one.

It struggled with such great strength, much greater than we ever felt with any other butterfly or moth in our hands, that after a good look we let it go. We were somewhat ashamed to find that quite a bit of its beautiful scale dust, was left in our fingers, but it flew off so rapidly that it did not appear to be hurt. We hope not.

Now I thought it time to tell the children that this marvel of a moth is called the humming-bird moth. They agreed that that is a good name for it. Then, as a surprise for them, I could say further that the humming-bird moth came from the very same kind of caterpillar that they had found on the tomato vine. And that next spring they would have three like this splendid moth all their own. They then went to see if the cage in which the chrysalides were buried was all right and they looked on it with the tenderest care.

And now again we had the same cause for wonder as with the other caterpillars we have watched. How could such a big fat fierce looking caterpillar, gorging itself on tomato leaves, turn into such a fine large creature, clothed with the softest coat possible, painted with the most delicate shades of colors, furnished with fine big eyes and with such a marvelous tongue, that can reach and sip the sweet nectar down at the bottom of the long shaped flowers, and, most wonderful of all,

move with an especially swift, strong and true flight? Surely no one looking at the big green tomato worm, and then at this moth among the flowers, could ever imagine that one animal could change to another so very different.

The fine beauty and strong flight of the humming-bird moth, stirred up our interest in it enough to make us try to find out more about it. It was our good fortune to have a friend who has a collection of moths. There, amongst them was our beauty of the garden. We could examine more closely its size and color. The largest one measured from tip to tip of the fore wings five inches. The colors were not brilliant as in some butterflies, but were of the most beautiful shades of gray and black, most delicately arranged. Across the back wings were some wavy black lines. The body was gray and on each side was a row of five yellow spots. For this reason, it is sometimes called the five spotted Sphynx. It is also sometimes called the tomato Sphynx.

In the collection were other moths that might be cousins since they are somewhat like our moth. We learned that our moth with its cousins, are called Sphynx moths, or sometimes Hawk moths. They have been given the name Sphynx because their caterpillars, when they raise their bodies and heads and look solemn, are thought to look like the great statue near the pyramids in Egypt called the Sphynx. They are called Hawk moths because they have such strong wings and splendid

power of flight. They are of different sizes. All come out about dusk and have a strong rapid flight. Some of them are even more beautiful than our humming-bird moth. The caterpillars of the different kinds are usually green and have the habit that our caterpillar had, of raising up its head and looking fierce. They feed on different kinds of plants. Most of the moths are not as large as ours was. They burrow in the ground to make the chrysalis. We may find some of these others in our garden. On page 213 is given the picture of the white lined Sphynx. Its caterpillar feeds on many kinds of plants.

When we talked to a man who has a big garden of vegetables and flowers about our tomato-worms and humming-bird moths, he was interested but he was somewhat perplexed as to what to do, now that he had learned that they were the same animal. He said that the tomato-worms were such big greedy things that it did not take them long to eat up a whole plant. That sometimes they came in such great numbers as to destroy a big patch of tomatoes. But then the Sphynx moths did a lot of good. When they visit flowers and thrust their tongues down the tubes, they carry the pollen from one to another and this is very necessary. For without pollen the flower will not make its seeds.

Now if he killed the worms there would be no humming-bird moths. If he did not kill them the moths would lay eggs in the tomato vines

which would hatch into tomato-worms. So there was his puzzle. I think he finally killed all the tomato-worms he could and trusted to the luck of having some other kinds of moths carry the pollen about. He says that every year he plows up many of those "jug handle chrysalis things." He didn't know what they were before. He has not yet decided what to do with them.

This kind of caterpillar also feeds on potato vines and tobacco plants. For this reason it is not liked by potato and tobacco farmers any better.

There are some enemies of this caterpillar which help the farmer to kill it. They are the kind that destroy the milkweed caterpillar. You, no doubt, remember that we told you about its sharp piercing probe, with which it makes a hole in the back of the poor caterpillar and then lays its eggs deep in its body. The eggs hatch in the caterpillar's body, and the larvae eat its flesh, and then at the right time come out and spin their little cocoons which they fasten to the skin of the poor caterpillar. It is no pleasant sight to see the caterpillar carrying around the parasites who are eating the life out of it, and are ready to fly away as the poor thing dies from their cruelty. These insects are called Ichneumon flies.

Tomatoes are good to eat and we do not wish to do without them. But I hope that when the farmers and the Ichneumon-flies get after the tomato worms that they will miss a good number of them, so that the beautiful and very useful hum-

ming-bird moths will still be numerous enough to make us glad and help out the flowers in their work. At any rate the tomato-worm learned to eat the tomato vine ages before human beings found out tomatoes were good to eat. So doesn't it have some rights about tomato plants?

A GENTLE TIGER

There roams in the forests of India in Asia, a big savage cat-like beast. It has glaring eyes, great sharp teeth and claws. Its body is tawny or yellowish with black stripes. It will steal out at night and pounce upon and carry away a sheep, a calf or a man. We all know of this terrible animal as the Tiger. Men have caught them and put them in strong, iron cages and brought them to this country to show in the circus or the Zoo. Nearly every one has seen this fierce animal and admired its beautiful coat. Just think what a terrible thing it would be to meet it, alone in the forest.

In the country where it lives, no one would dare to take a walk alone through the Jungle.

In our woods we have a Tiger too. But it is beautiful and harmless, and as lovely as a flower. It is the big, beautiful butterfly that goes by the name of the Tiger swallow-tail. It gets its name because, like the tiger of India, it is yellow with black stripes. And that is the only thing in which they are alike. The fine tiger swallow-tail draws or attracts you to the woods, instead of driving you from them.

It is a splendid flier. Its great wings are more than four inches across. Its bright yellow color

and its lively movements make it appear to be very happy. It seems to be saying, "Isn't this a nice place?" as it floats about joyously flapping its great wings.

Its large size and bright color allow you to see it a long distance away. It is a bright spot of yellow,

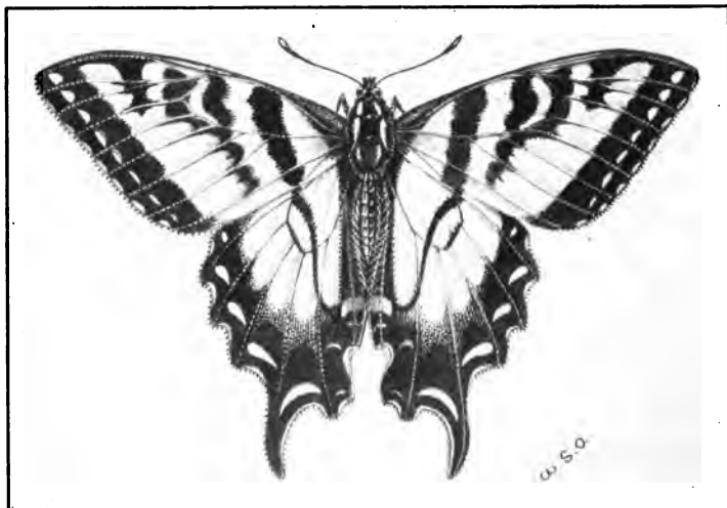


FIG. 39.—The tiger swallow-tail.

now moving over the bushes, next high among the trees. It is not easy to catch when flying about among the trees. It may come into our garden seeking flowers. It is very fond of lilacs and when it settles down on a blossom to sip the nectar it may easily be captured. A curious thing about this beautiful butterfly, so fond of lilacs, a thing you would hardly believe of it, is that it will also alight on badly smelling decaying matter and take a sip.

If you can get one to remain quiet, you can then see its markings better. The main color of the wings is a bright yellow. The borders are black with a row of yellow spots in them. The fore wings have each four black stripes and the hind wings one black stripe across them. The edges of each of the hind wings are scalloped and each wing ends in a sort of long narrow piece like a tail. These give the name swallow-tail to this butterfly.

There are other kinds of butterflies that have their hind wings end in tails in this way. This group is called the swallow-tailed family. There are some other very large and beautiful swallow-tails beside the Tiger Swallow-tail.

Since we have learned that all butterflies come from caterpillars, it would be interesting to learn what kind of caterpillar makes the Tiger swallow-tail.

In the first place, its caterpillar is not so particular about what kind of leaves it eats as some caterpillars are. It does well on the leaves of many different kinds of trees or bushes. So the tiger may lay her eggs on fruit trees



FIG. 40.—The caterpillar of the tiger swallow-tail.

or the wild cherry, among many other kinds of trees.

When the caterpillar of this butterfly is fully grown, it is odd looking and certainly not beautiful. Just behind its head the body is very thick. This makes a sort of hump. On the top of the hump are two yellow spots that look like two large staring eyes. They are not eyes but only colored spots on the skin, as if false eyes were painted there. Just behind the hump is a white band that helps to make it look threatening. Then to help the fierceness of the look more than ever, it has two yellowish colored horns which, when it is disturbed, it brings out from a hidden place just behind the head and waves back and forth. Indeed it looks as if this caterpillar was made up as a scarecrow. To make things more disagreeable, the horns give out a very bad odor when they are waving. It is thought that all this display is to keep birds and other enemies away. And it is true that this caterpillar is not troubled by birds as much as some kinds are. Here is a case where it pays to be ugly.

This caterpillar knows how to make a very comfortable and curious sort of hammock to rest in when it gets tired of eating. It finds a good leaf and spins a quilt of silk and fastens the edges of it to the opposite sides of the leaf. The quilt is in this way stretched tight and makes a fine place to lie on. The painted face seems to glare at you and say, "Don't dare step on me if you know what is good for you."

We have seen that the silk-worm spins a cocoon. That the milkweed caterpillar makes a beautiful case for a chrysalis. That the tomato-worm buries itself in the ground to form its chrysalis. The caterpillar of the Tiger swallow-tail has a still different way. When it comes time for it to form a chrysalis it crawls away to a place of safety. Like the milkweed caterpillar it spins a button of silk and glues it fast to a support. It fastens the hooks of its hindmost pair of feet in the button. While it hangs from this, it spins a band of silk fastened at each end to the support. The band is about at the middle part of its body. It then manages to get its head through the loop of the band. It then rests its body in the loop as if it were a little swing. This silk loop holds the caterpillar while it is shedding its skin to become a chrysalis and while the chrysalis fastens its rod of hooks in the silk button. The silk band and button hold the chrysalis till the butterfly comes out. Many other kinds of caterpillars spin a silk loop to hold up the chrysalis in this way.

If you could have the good luck to find a chrysalis or rear one from a caterpillar, you would see a fine sight in the coming out of the new tiger swallow-tail from the narrow walls of the chrysalis. Like all butterflies it is at first very damp and weak. Its wings are small, thick and wet. But soon they stretch out to their full size and color and the tiger is ready for its happy life.

Tiger swallow tails are found in most parts of the

United States, so wherever your home is, in this country you are pretty sure to find it. There are a number of butterflies that belong to the swallow-tail family. The largest one is the Giant swallow-tail which may grow to be as much as five and one half inches across. It is the largest butterfly known in North America. It is mainly found in

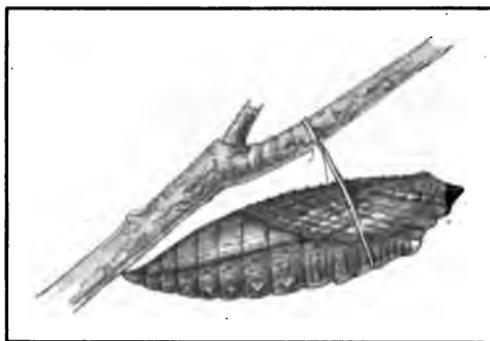


FIG. 41.—Chrysalis of tiger swallow-tail.

the Southern States. Its caterpillar likes orange and lemon trees. Another fine large one is the Black swallow-tail. It is found in every state of the Union. Its caterpillar is always found on plants of the parsley family, such as carrot, celery, caraway and parsley.

The swallow-tails are so beautiful that lovers of butterflies are always on the lookout for them. They have a large place in the collections in the museums, and the libraries have many books with beautiful pictures of butterflies found in many countries beside our own.

EGGS ON POLES

On a warm summer's day, I sought the shade of a cozy corner in the garden. In this cool nook, a seat had been placed where the lover of out-door life could enjoy not only the charming fragrance of the flowers, but the sturdy growth of the garden food plants and the busy life of the thousands of insects that rushed about their work, as if the garden was made for their especial uses and belonged to them.

Footsteps crushing the gravel on the walk and lively voices, foretold that the children were coming, and in a hurry. They had found a leaf, on the upperside of which was what seemed to be a strange kind of growth. This growth was a group of about a dozen very delicate white stalks half an inch high. On the top of each stalk was a tiny white body, looking like a little pearl.

The children wished to know if it were some kind of mould. Or might it be some kind of tiny mushroom. Whatever it was, it was certainly a very dainty thing to look at and a mystery worth investigating. It so happened that I had been wishing to find this very thing to show the children as another one of the strange and curious ways of insects.

They were highly pleased on learning that this

tiny forest of little pearls, was a group of the eggs of a very beautiful little insect that had the charming name of Golden Eyes. This little



FIG. 42.—Eggs on stems laid by the lacewinged fly are on the top leaf. They hatch into *Aphis-lions*. A grown one is on the leaf at the lower right. This forms the little round cocoon on the leaf next to it out of which in time will come a lacewinged fly.

animal was not only beautiful but wise.

Now, many kinds of insects lay their eggs on the leaves, stems or bark of plants. Most of them glue the eggs right down flat on the surface.

There are many other kinds of insects that think as highly of these little eggs for food as we do of hen's eggs.

So they go egg hunting all over the plants, very carefully searching every leaf and every crack and corner of stem and bark. But Golden Eyes is up to all their tricks and does one of her own that they do not know about.

She spins a very delicate white silk thread-like rod or stem, about half an inch long and places her pearly white egg on top of it. The stem, although very fine and thin, is quite firm and strong and holds the egg very securely, high above the heads of the egg hunters. She erects about a dozen poles in a group. The insect egg-eaters do not seem to have very good eyes. At any rate, they are not clever enough to look up, but go nosing around on the surface of the leaf and even right among the silken poles and miss the little pearls on the top of the poles. Some people are that way. They miss many fine things by keeping their eyes always on the ground instead of looking up once in a while.

Well, of course, the next thing to do was to give the children a sight of Golden Eyes. That would be easy, as the little beauty was rather common and sure to be found somewhere among the plants.

They were told that she was also known by another name, the Lace-winged Fly. Well, either name showed that the animal must be worth seeing. So we began a journey around the garden world,

searching for a being with golden eyes and lace wings.

It was not long before I spied one perched upon the leaf of a lilac bush, and called the children, who lost no time in coming to where I was. "Go slowly," said I "and be perfectly quiet or she



FIG. 43.—Lace-winged fly.

will get her golden eye on you, then spread her lace wings and bid you good bye. We wish to have a good look at her first." Well, there she was in plain view and her beauty was no disappointment. She is a small person, about one half inch long.

The body is a light green, the feelers (antennae) are very long and slender. The eyes are well named golden. They are bright as polished gold. Her large wings are of the most delicate lace-like

pattern, and finer than any made by the best lace makers. They are of a beautiful shade of green and almost transparent, and as they move show tints of rainbow colors. The whole insect is most daintily formed and may well claim to be one of the most beautiful of the insect world.

"O! isn't she a darling," cried Bessie. "Let me hold her in my hand." "Just wait" said Tom, "I'll catch it for you." So just as Golden Eyes made a start to fly, Tom grabbed her with his hand.

"Phew! what do you know about that?" exclaimed Tom and added with some vigor, "The little skunk" And that, I am sorry to say, is about the correct word for her. For, among insects, she holds a place similar to that of the skunk among the larger animals. When caught she throws out a very disagreeable odor. Bessie ran to Tom with her handkerchief to wipe the smell off his hands. But it only made the handkerchief have a bad odor for a day or two, and it couldn't be used again till it was washed.

Tom gladly let the lady with charming looks and very bad manners, spread her fairy lace wings and fly away with her golden eyes. It is astonishing how any one who looks so nice, could turn out to be so disagreeable when you come to know her better. But we must not blame dainty Lace-wing, for since she cannot bite or sting like some other insects, she is given this way to take care of herself. To her, no doubt, Tom looked like a giant with big eyes and enormous hands which seemed ready to

crush her and forever spoil her exquisite lace-like wings by crumpling them up.

But there are other things to be learned of the Lace-winged Fly. We wished to find out what the children hatched from such dainty pearl-like eggs, laid by such a charming looking mother, would turn out to be.

Well, this is their story. A tiny dark colored insect baby comes out of the egg. Its first work is to climb down its silken pole. And then what? Eat, eat, every insect egg it can find and catch every little insect it can lay hold of, slay it and suck its blood. It is just a savage little beast. Why it would even eat its sister eggs if they had not been placed up on poles.

It does not take after its mother in good looks. When it grows big enough to be seen—well, about half an inch long, you find it has a rough, homely body, with dark yellow and reddish color marks. Its mouth is armed with two curved, sharp pointed, hooked jaws, that come together like pincers.

With these pincers it seizes any insect it meets and holds it until it sucks out its blood. It is especially fond of plant-lice but is such a greedy creature that it does not stop at plant lice, but will seize any insect it meets that is not too big for it. So it may destroy some eggs and young of insects that are our friends, such as the lady-bugs. But it is such a good plant-lice killer we must think of it as our friend in the garden.

Because it is very fond of plant-lice gardeners

who understand it are very glad to have it on their plants. But many have not learned what a friend they have here. People who have studied the savage little children of the Lace-winged Fly, tell of the enormous number of plant-lice a single one will eat in its short life. Because of its savage work on plant-lice, it is called the Aphis-lion. Aphis is the name of plant-lice. Since it takes only the blood of its prey and throws the body away, it takes a great number to satisfy its hunger.

After about two weeks of vigorous hunting and slaying, the Aphis-lion feels a change coming over it. It finds a comfortable place on a stem or leaf and rolls itself into a small ball. It then spins a small round cocoon of shining pearly white about the size of a small pea and then waits for the great change that is to come to it.

Before many days have passed, the little thing inside of the pearl-like cocoon cuts a neat round lid in the top and, wonderful to tell, first there peers out a pair of golden eyes and then follows the dainty green body and beautiful lace wings. Our little lady, Golden Eyes, elegantly dressed just out of a bandbox, is now ready to take her flight and take up the work of staking out poles, each with a pearl egg on top, and things in Lace-winged Fly life are beginning over again. You must agree that to change an ugly savage Aphis-lion into an elegant Lace-winged Fly, is as wonderful as turning a homely caterpillar into a beautiful butterfly.

So the mystery of the eggs on poles was solved and we have here a great friend. Tom now only laughs at the way Golden Eyes tried to keep him from rumpling up her wings.

Now when the children find any more eggs on poles, or hatched-out *Aphis-lions*, they bring them in and place them on rosebushes and plants that are infested with plant-lice. They have forgiven the bad manners of Golden Eyes and still admire her dainty beauty.

THE ANT-LION

If you were asked to name the most savage and frightful animal you would almost surely say the lion. Of course tigers and wolves are also very terrible, but the lion is so large and strong and has such great claws and teeth, that he seems more frightful than any other animal. Then he has

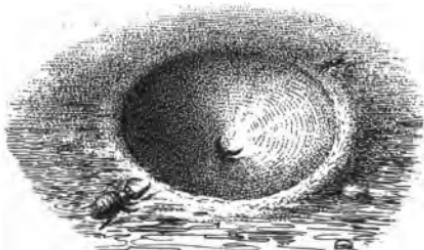


FIG. 44.—Pit of the ant-lion. An ant-lion on the surface of the ground at the left. The jaws of one are rising from the bottom of the pit.

such a savage look with his great mane and has such a fearful roar, that he strikes terror in the hearts of those who live in the lion's country.

Around us, we see the world of insects crawling and flying about hunting their food on the ground, through the grass, or on the bark and leaves of the trees. We might think that they are always happy and having a good time. But when we come to know them better we find they have their

troubles as well as we. It gives us an unpleasant feeling to find that many of them are as savage to other insects as lions are to antelopes, deer and men.

One is so fierce towards ants and other small insects, that it is called the ant-lion. It is not only fierce but you will think it very crafty because it digs a pit to trap the poor ant and when it catches its victim it pierces its body and sucks its blood.

The pits of the ant-lion are very pretty and look very innocent. No doubt you have seen them. If not, you can very easily find them in most parts of the country.

The first I ever saw, were in the woods where I used to ramble. They were made in the fine dust that came from a log that had been rotting a long time. They may be found in sandy places, such as may be found at the bottom of cliffs. They may be seen under houses or at the edge of sand banks. Sometimes there are a number of them close together.

The ant-lion must have fine dry sand or dust, in which to make its pit. The pits are round at the top an inch or two in diameter, and each tapers down to a point at the bottom of the pit. That is, the pit is cone shaped, only the cone is upside down, like a funnel. The sides of the cone are as steep as the fine sand will allow.

But where is the ant-lion? When I was a child, when we found some ant-lion pits, we would bend

our heads close down over them and cry "Mooly up, mooly up," and we thought sometimes something made a motion at the bottom of the pit. We used to call them "Mooly ups." Well if you look closely, you do not need to shout any thing to see sticking up at the bottom of the pit, a pair of curved pincers. Those pincers belong to the ant-lion which is buried in the sand waiting to do a savage piece of work.

This is how it uses its 'pit. Here comes an ant hunting for food. She comes to the edge of the pit. The sand is so loose, that it gives way under her feet and down she slides. When she tries to climb out, the fine dry sand slides her further down. If she almost gets to the top, the ant-lion from the bottom of the pit throws piles of sand over the poor ant and she is bound in time to slide down to the bottom of the pit and the ugly lion pierces her with its curved pincers, and sucks out her blood. When the ant's body is sucked dry the ant-lion throws it out of the pit, and makes ready for another victim.

It is easy to dig an ant-lion out of its pit and have a look at it. It is not a pretty thing to look at. It is something like an aphis-lion, which we learned about on page 140, but it is larger and its body is thicker, and about half an inch long.

It is grey with some specks on it. Its body is rough and has little bunches of short hairs on it. The most striking thing about it, is the pair of jaws that stand out from the head. Each has a

sharp, curved tip meeting the other and the inner side of each is furnished with a row of sharp teeth. They are pincers that no insect can get away from. Through the sharp curved points, it sucks out the blood of its victim.

There are a number of kinds of ant-lions. They differ somewhat from one another but they are all much the same as here described.

It is a very interesting sight to watch the ant-lion make its pit-fall. This you can do by digging



FIG. 45.—The winged adult of the ant-lion.

out an ant-lion and placing it on some dry sand placed in a box.

It first marks out the plan of the pit by ploughing out a furrow in the form of a circle which is to be the size of the top of the pit. It uses its body for a plough, crawling backwards. It next ploughs out a circle inside of this. For a shovel, it uses its head. It pulls a load of sand on the top of its head, with its fore legs and then with a quick jerk, throws the sand clear out of its pit.

It keeps up this ploughing and shoveling until it has a beautiful smooth pit. Then it buries itself,

in the very bottom, leaving in sight only a part of the terrible pincer jaws, ready to seize the poor ant that slides down to them.

When it throws sand up on the ant as it tries to crawl out it uses its head for the shovel in the same way as when digging the pit.

We have seen how caterpillars become beautiful butterflies and how the homely aphis-lion changes into the beautiful golden eyes. Well, this ugly ant-lion makes as remarkable a change. After a life of hiding in the sand to carry on its murderous work, it becomes quiet, spins a cocoon and takes a long sleep, still buried in the sand. Then it comes out a large slender bodied flying insect, with large and very delicate beautiful wings. It looks something like a dragon fly. It hides among the limbs and leaves of trees and plants. Its main work is to find a good sandy place in which to lay eggs, which are to hatch out into ant-lions.

These, if they are in a good place, soon begin to make their pit-falls and the children of the beautiful lace-winged insect, become the homely murderers of innocent ants.

SOME WAYS OF THE DANDELION

THE CHILDREN LEARN SOME OF ITS TRICKS

Company had come. Every body was busy preparing for a good time. The most important members of the company were two cousins by the names of John and Nancy. This visit had been long wished for by Tom and Bessie and now they were really here. Things long planned for, were actually going to happen. There were new games to be tried. There were to be picnics. The hickory nuts in Sleepy Hollow were to be gathered. The Robber's Cave over in Miller's Gulch must be explored.

These delightful things followed one another in a procession of beautiful and happy days. The bright memory pictures of the good times are now stored away where they can be taken out and enjoyed, even when years have slipped by.

One bright morning, the children were sitting around on the grass under a tree, planning how to spend the day, for the visit was fast coming to an end. When the gardener, passing by said, "Just look what the dandelions have been doing while I have left the lawn to cart you little people around on your excursions." The children looked up and glanced over the lawn. Sure enough, the dandelions seemed to be having a celebration. All over the



FIG. 46.—The dandelion.

lawn, they were holding up tall round stems bearing aloft the soft round balls that everyone knows so well.

The children jumped up and ran helter-skelter over the lawn, each one grabbing as many stalks with the balls as he could. Each one of course trying to out do the others in the number he or she could gather. Then came the old game of seeing who could blow off the most down from a head with a single breath. As you might well know they soon began blowing the down into one another's faces, with much dodging and laughter. Then they split the hollow stems to see them curl up as dandelion stems know how to do, each one trying for the longest curl. These the girls hung over their ears and shook their heads to make these dandelion curls dance in a lively frolic, in the way girls know how to manage their real curls.

The gardener enjoyed seeing the romping, but when they settled down a little, he said to them, "The dandelions are great fun to you children, but I can tell you that they are no fun to me. Do what I can, I can not get rid of them." "Why don't you dig each one up," said John. "I think that would finish them."

"Well, that has been done more than once, but they soon show up again," answered the gardener. He went on to say "The dandelion is a very clever little plant in many ways. One of them is the way it plans to get its seeds planted far and wide. I was just thinking when you were having

your fun with the down heads, that the dandelions were laughing down in the grass at the way you were helping them out. Bring me one of the down heads, and let me show you the dandelion's plan."

Nancy was quick to get a nice big one on which the down was still perfect. The gardener took the stalk, and taking the head apart carefully, showed them that the downy part was made up of a large number of tiny downy heads. Each little downy head stood on a very slender little stalk and at the bottom of this is a very small seed. The tiny seed is really the passenger of a beautiful little balloon. The gardener blew a crowd of the little balloons high up in the air. A good breeze that was blowing at the time, carried them away till they were out of sight.

"There" said the gardener, "some of those seeds may land on the lawns in the next town, if this wind keeps up. Why," he continued, "who knows but that some of the dandelions in this lawn were planted by balloons which sailed all the way from those growing in the lawn at John's and Nancy's house, fifty miles away. For with a high wind the dandelion-balloons might travel very much farther than that. This is the way the dandelion plants its seed over the United States every year." The children were greatly interested and rushed out to gather heads and blow the down up in the air and then each tried to guess in which town his balloons would land. Not knowing geography

very well, I think they made some poor guesses but that did not bother them very much.

Tom got to thinking about those balloons. He wished to know how a plant could build a balloon to carry seeds so perfectly. The gardener had them gather some downy heads, some flowers and some flower heads just opening. They sat down on the grass under a tree, the children pressing close about him.

He showed them first that the yellow flower as we call it, is really a bunch of many tiny flowers crowded closely together. If one of these tiny flowers is looked at by itself, it is a pretty flower with all the flower parts. At the bottom is the part that is to become the seed. Just at the top of this is a very small bunch of fine fuzz. As the seed ripens, a thin delicate stem stretches up between the seed and the fuzz. The fuzz grows to be the downy top of the balloon.

In this way the bunch of tiny flowers makes a group of little balloons ready to sail away. While the balloons are growing, the big hollow stalk that holds the whole bunch, rises up pretty straight and brings the bunch of balloons higher up in the air ready to catch the breeze.

The children Oh'd and Ah'd to find that such a common old plant as the dandelion could have such wise ways. They could now understand how it was always ready to turn to you a bright golden, smiling face, no matter how rudely you treated it. For it knew it would get ahead of you at last.

Bessie said that she was glad to learn that dandelions were smart enough to beat the gardeners. For she thought the bright yellow spots on the lawn were as beautiful as the green grass. And then too in the countries where they have cold, snowy winters, the jolly smile of the dandelion is the first flower to tell you Spring has come.

The gardener laughed and said that he still had to be careful and not let the dandelion smile too much on the lawn, or Bessie's mother would not smile very much on him. John asked the gardener if it would not stop the scattering of the seeds if he would run the lawn mower often enough to cut off all the flowers, before they went to seed. He thought the lawn mower might even get the buds before they had blossomed. "Come" said the gardener, "let me show some more of the artful ways the dandelion has of taking care of itself."

He then showed them how the leaves of the plant that came out of the top of the root, turn back and lie very flat against the ground, so that the lawn mower would pass right over most of them. The flower buds too, lie down flat much as the leaves do, to dodge the lawn mower until they are ready to bloom and ripen the seeds. Then the flower stems grow tall and straighten up, for then they do not care who knocks them over for that would set the balloons flying any way.

Everybody agreed that these were truly wonderful ways for a mere plant to have. But the gardener said that there are still other wonderful

ways that this common plant has. Now there is the flower, that is, the big flower. It has all the little flowers in it. What wise ways it has!

In bright sunshine, when it is very important for the plant that bees visit it to get the pollen and carry it from flower to flower, it opens wide. When storms arise or when cold night comes on, the row of little green things that make its border, shuts together over the bunch of little flowers, holding them tight from danger. Then when the seeds are ripening and the balloons are growing, this green border-row closes in and shuts them up securely, so that they don't get knocked off till all is ready. Then they open wide and let the head of little balloons stand up to be blown away.

The gardener then told them that since they now know something of the ways of the dandelion, they think it wonderful. But that every other plant has ways of its own as artful as those of the dandelion. "They have just got to have them" he said, "or they could not keep themselves going on the earth. Now just take the ways of getting themselves planted. You think the dandelion has a wise way. So it has. But every plant has some way to scatter its seeds, and some of the ways they practice are as clever or even more so than are those of the dandelion." "Tell us about them," cried John. "Yes tell us," all joined in.

The gardener thought a moment and then said "I'll tell you what I'll do. I've got to cut this lawn this afternoon. But tomorrow we'll

take a tramp into the fields and woods and I will show you where you can see for yourselves, how some other plants manage to sow their seeds."

"Hurrah! That's a bargain," they shouted and all joined hands and danced a ring around the gardener. He grinned and looked foolish but you could see he was pleased. The party broke up, he to work on the lawn, they to do the thousand and one things that happened along before night. When bed time came, the general question was, "What do you suppose we will find tomorrow?"

THE BAND OF SEED HUNTERS

BALLOON SEEDS

A chance for a tramp through the fields and woods, even if it were after nothing at all was always hailed with joy. There was no trouble about getting up early and down to breakfast in good time. The mothers were glad to have the children go on such a good outing. The gardener had no trouble in getting a day off to plant seeds of knowledge in the children's minds instead of pulling up weeds in the garden. There was a fine lunch put up, for of course it must be a picnic if you go to the woods. A good number of little paper bags and boxes were taken along to put the new seeds in. Of course there was no thought of going on a tramp without Gyp, the collie. And you may be sure that Gyp never for a moment thought that they would go without him. So with him running on ahead, the gay little company marched down the road.

Soon they came to a field and it took no time to scramble over the fence. "O there's a bunch of thistles. Let's see what they do," some one called out. There were quite a number of the plants. Some were in beautiful bloom and some had already gone to seed. The bumblebees were crawling over the soft flowers, after pollen and nectar.

The plants with the sharp little bayonets that covered stalk, leaves and the outer parts of the flowers, made the children stand back a bit. But the boys got some sticks and smashed down the plants and burst open the flowers.

They found that the big flower, like the dandelion, was really a great number of little flowers crowded together. As the seeds ripened, each one had at its top a fuzzy little balloon, like the dandelion, only larger. The balloon did not have a stalk between it and the seeds as in the dandelion, but was fastened right on top of the seed. When the flower had gone to seed it was no longer colored but was changed to a white fluffy mass. The children found that they did not

have to break it open, as it was easy to pull out a bunch of the seeds with their balloons with the thumb and finger. When thrown up in the breeze, they would go sailing away out of sight. The gardener showed them that the seed was very easily broken away from the balloon. So that if the balloon bumped against a tree or fence, it would be pretty sure to drop the seed right there. A fence corner is a fine place for a thistle to grow in, for it is likely to be missed by the plow or hoe in that safe place.

They gathered some of the seeds with balloons for their boxes. They found some other kinds of

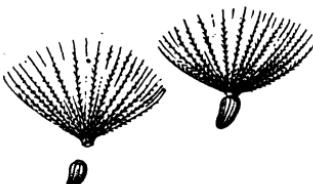


FIG. 47.—Thistle seeds.

thistles that day and all of them had about the same kind of an airship in which to send out their seeds to bomb the fields with. It was easy to see how hard it is for the farmers to keep down the thistles in their fields, when these millions of seeds are so well scattered every year by the wind.



FIG. 48.—Pod and seeds of milkweed.

In starting out again, Bessie shouted, "I see a milkweed with some pods on it. I remember now that it has some very fine threads on its seeds as soft as silk. Some people call it silkweed." So the milkweed pods were next gathered and the purse-like pods carefully opened. Nothing could be neater than the beautiful way in which the

thin, flat seeds were packed in the pod, one overlapping the other. Each one had a tuft of long hairs as fine as the finest silk. The long silky hairs were laid out so as not to get tangled in the least. They all agreed that those who have not seen the milkweed seeds in the pod have missed a pretty sight.

When they took the ripe seeds out and threw them up into the air, the tuft of long silky hairs spread out into a finer balloon than even the dandelion or thistle seeds had. The children clapped their hands as the glistening balloons floated gracefully on the breeze.

They were glad to hear that the farmer does not think the milkweed is a very troublesome weed like the thistle, so he doesn't care if it does plant itself around the country.

Nancy spoke up; "O yes, I remember now reading a story about a beautiful butterfly called the Monarch. But it is sometimes called the milkweed butterfly, because it lays its eggs only on milkweeds. The caterpillars which hatch out from its eggs will eat only milkweed leaves. If all the milkweeds were to die there would be no more Monarch butterflies."

"Hurrah for the milkweed," cried the children. "Long may her seeds wave their silky hair!" The gardener laughed and said Nancy was right and that if they had not already as much as they could do today in looking for seeds, they might try to find some milkweed butterflies, their eggs and

caterpillars. "But we can leave that for some other day," he added.

Not only the milkweed balloons but the interesting pods went into the boxes.

SEEDS THAT STEAL RIDES

The next plant that stopped them was a group of burdocks. "O here's the plant that made so much trouble in our school one day," called out Bessie. "How was that?" asked the gardener. "Well," replied Bessie, "a boy named Clarence

Joyce, who sat just behind Mabel Sweetser brought a lot of the burs to school and stuck them in Mabel's hair."

"How horrid!" said Nancy. Then Bessie told how Mabel cried and went home and what an awful time they had getting the burs out, and how Clarence was sent up to the Principal, and how he came back with red eyes, but would never tell what happened.

The gardener asked what did they do with the burs they got out of Mabel's hair. "Why, I guess they just threw them out in the yard." "Then," said the gardener, "you see how the burdock got its seeds planted, for the seeds are in the bur." "Oh, I see," said Nancy, "If a dog or a fox should come along and the burs get stuck in his hair, they could take a ride and get planted in another place." "That's just it," said the gardener.

"Let's try it on Gyp," called out Tom. The girls thought that that would be too bad, but the

FIG. 49.—
Burdock bur.



boys promised to put them on Gyp's back and tail so that they would not hurt him and so they placed a dozen burs on his back and tail. Later in the day, when all were getting out the lunch, Gyp got tired of being a bur bearer and lay down and deliberately picked bur after bur out of his fur with his teeth. "Look at Gyp planting burdocks," said John.

Well before they left the burdock patch, Nancy showed the rest how to make bur baskets. The many sharp hooks with curved ends all over the surface of the bur made it easy to fasten one bur to another. In this way they made baskets, bowls and other forms, as their fancy suggested.

As they went on, they found other plants with fuzzy balloons to carry away their seeds. Some, like the wild lettuce, are so very tiny that the wind soon carries them out of sight. Some are not such good sailors as the dandelion. The children then gathered several seeds whose names the gardener did not know. They found so many of the ballooning kind, that they came to the conclusion that that was a common way for plants to scatter their seeds to new fields.

The gardener called them over to see a big weed which he called a tumble weed. He explained that, in the fall, the branches of the plant turned in toward the center so as to make a big loose ball, as much as two feet through. Then the stem, right at the ground, would rot off and this ball was ready to be rolled by the wind across the field. He said

that he had seen the balls of tumble weeds rolled along by the wind for great distances on the prairies, where the land was for long distances flat and there were no trees to stop them. If a fence or barn should happen to be in their way these weeds would pile up high against it. Of course as the tumble weed bumped along, some seeds would be shaken out, and where the weed was stopped many seeds would fall down when the rains came. There are several kinds of weeds that act this way, and for this reason they are called tumble weeds. Well, the children could not take this big fellow into their boxes, so they stored it away in their memories. And that is what they had to do with some other things they saw that day.



FIG. 50.—A
cocklebur.

Tom was looking over the fence into the next field when he called out to the gardener, "What is the matter with those horses? Their tails look like clubs." "Well, we will just go over and see," replied the gardener. "I know those horses and they are all very gentle." It did not take long to find out what made the nice flowing tails like stiff clubs. They were full of what the gardener explained were cockleburs.

The gardener caught one of the horses. Not only its tail, but its foretop and mane were matted with the ugly burs. The horses had been feeding down in the bottoms where the cocklebur plants grew in great numbers. "It will be many a day

before the poor animals will get rid of these pests," said the gardener, "and by that time the burs, which are the seeds, will be scattered over long distances. No wonder the cocklebur is called a vile weed." The children went down to the bottom lands to see the plants and gather some of the seeds for their boxes. The seeds were covered with strong, sharp hooks and at one end was a larger, stronger pair of hooks, which looked like the jaws of a savage insect.

While they were down in that part of the field, before they knew it, their stockings and even Gyp's tail got covered with what the gardener called Spanish needles. These were slender brown seeds about half an inch long. On one end were two sharp needles with barbs on them, turned backward. They would pierce clothing easily but the barbs would hold them from coming out easily. "Dear me," said Bessie, "Let's get out of this." The gardener chuckled and said "Why isn't this just what you came out for, to gather seeds?" "Well I've gathered enough of that kind," she replied. "I suppose when those plants saw us coming, they thought now's our chance to get a free ride and a new home."



FIG. 51.—Spanish needles. Two heads of the plant. A single seed at the right slightly enlarged to show the barbs.

Since it was getting near to lunch time, they turned toward the woods. At the first good place they came to, they sat down and picked the Spanish needles off of their clothing. These also were saved for their boxes. The gardener told of many other plants that furnished their seeds with hooks by which they could cling to the fur of passing animals and get carried, sometimes long distances and there plant themselves in new ground. "You will see more of that kind before the day is over," he said.

WINGED SEEDS

While they were busy at the luncheon under a fine tree, a breeze shook the limbs and a flock of

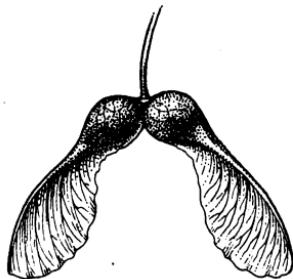


FIG. 52.—Maple tree seeds.



FIG. 53.—Winged seeds of the elm.

sailing things filled the air above them. Some rattled down on their spread out dinner, and others were carried far beyond. "Maple tree seeds," cried some one. Up they jumped and each gathered a handful before sitting down again to

finish the meal. The maple seeds were old friends, but as the children had never before stopped to examine them very carefully, the morning's work with traveling seeds led them to give the maple seeds a careful study.

The seeds were in pairs. It was very easy to see for what use the beautifully shaped wing had grown out from each seed. They tried throwing them up in the wind, and while some would reach the ground but a short distance away, many, especially if the pairs were



FIG. 54.—Linden seeds with sailing wing.



FIG. 55.—Winged seeds of ailanthus.



FIG. 56.—Clematis seed.

broken apart, would be carried quite a distance.

The gardener explained that such seeds are called winged seeds. He showed the children how the seed of the elm has a wing that goes all around it, a flat, circular wing. The linden or basswood tree hangs its seeds from a dry leaf-like wing that

can catch the wind and sail a short way. He pointed out that the winged seeds did not usually carry so far as the balloon seeds, but still most of them managed to get out from under the trees own limbs, where they would have a chance to grow. What the children found of these were thought to be fine treasures for the boxes.

SLING SEEDS

After luncheon they wandered deeper into the woods. Some delicately beautiful flowers growing in a moist, shady place attracted their attention. The gardener said that here was a chance to see a plant with a still different manner of sowing its seeds. There were both flowers and pods on the plants. The gardener chose a well ripened pod and had the children watch closely while he gently touched it with his finger. The pod flew all to pieces, scattering its seeds in every direction. The children applauded that performance vigorously and then, of course, each one wished to touch a pod. Fortunately there were plenty of ripe pods to give each one the pleasure.

"What's the name of this flower?" asked Nancy. "Well, it is sometimes called Touchmenot. Another name is Impatiens, because it is thought to be impatient and does not wish to be touched. But the truth is that when the pods are ripe it is waiting to be touched. Its trick for scattering seeds lies in having in the pods little springs, which a light touch releases and the force bursts open

the pod quite suddenly and scatters the seeds about. While the seeds are not thrown very far, some of them get away from where the old plant is growing." He then told them that many other kinds of plants had interesting ways of throwing their seeds about. Indeed, some of them could fling their seeds several yards.

By the time the children were tired of playing with the touchmenots, it was time to turn in the direction of home. When they reached the fence around the woods, they discovered that a number of rough little seeds were sticking to their clothing. There were quite a lot on Gyp's coat too. They had gathered without knowing it, many more kinds of seeds that were looking out for a free ride.

They appealed to their guide, the gardener, to tell them what seeds these were and what kind of plants they came from. There were some small round ones, known as beggar lice, which were seeds from the plant called hound's-tongue. One other kind was a flattish seed from the tick-trefoil. These seeds were covered with fine little hooks that took firm hold on clothing or fur. Bessie spoke up; "I am just too tired to pick all these things off now. I am sure I can't lose them so I am going to wait till we get home." They all agreed with her, and Gyp, like most dogs, didn't seem to care a jot about the seeds sticking to him.

So off they trudged, feeling that a fine supper waited for them. At home they had interesting stories to tell and precious treasures to show. The

mothers praised them but insisted that all those beggar lice and other stick-tights should be cleaned off their clothing. They found this quite a hard task, but as it added to their collection of seeds they finished it faithfully.

Nancy said that she was going to take her seeds to her home and show them to her teacher. All thought that a good idea, for then the school could have a beginning of a collection of travelling seeds. The other children could find more kinds and in time they could have a fine show of seeds and learn a lot about the curious ways of plants.

Bessie's mother said she thought it very fine to go out and see how plants live. "Now," she said, "how would you like to find out in some of the books about plants, how some of them do in foreign countries." Suppose all of you go to the town library tomorrow and see if each of you can learn how some of the foreign plants scatter their seed, and in the evening we will meet and each one can tell his or her story."

Bessie said, "I know the lady at the desk, and I am sure that she will help us to find the books." The rest of the children hesitated a little, fearing that they might not succeed. As the gardener had already helped them much, they turned to see what he would say. He told them he thought that he could give them the names of some plants that would be interesting to look up. Thus encouraged, they began to think it a good plan.

John proposed that they call the meeting the

"Seed Story Night." And then they began to form their plans to visit the public library the next day.

SEED STORY NIGHT

The children had an active time in the library, looking through the books about plants. They ran across a great many hard words, but they had good help and by evening when supper was over, each was ready with a report for the seed story night.

BESSIE'S ACANTHUS

Bessie was called on first. She told of a great poet whose name was Goethe. Besides being a great poet, he was very fond of plants and spent much time in studying them. Once upon a time, he was traveling in Italy. There he found and gathered some pods of a plant called Acanthus, which grew in that country. He put them away in his room in an open box. One night he heard a crackling noise. There followed sounds of something striking the wall and ceiling of his room. This puzzled him at first. Then he found out that it was the pods of the Acanthus plant that had burst and thrown the seeds out with great force.

Bessie said that that was the way the pods of the touchmenot acted but the Acanthus was much stronger and threw the seeds farther. She learned that plants that throw the seeds about are said to have "sling fruits." She also learned another

interesting thing about the Acanthus and that is, that in ancient times the sculptors who made the beautiful temples in Greece, thought the leaf of the Acanthus so beautiful, that they copied it to ornament the tops of the marble columns. Columns ornamented in this way are called Corinthian columns.

JOHN'S COCOA-NUT TREE

John's report was called for next. He told of a tree that lives on the coral islands of the Pacific Ocean. This tree protects its seed by covering it with a tough husk of fiber, which serves as a kind of boat to carry the seed over the sea, so that it may plant itself on an island distant from its home. It is the cocoa-nut tree. Its seed is the cocoa-nut which we all know so well. But when it is brought to this country the boat part is cut away. He had some pictures which showed how it looked before the nut was taken out of its husk. The outside covering is quite large and is hard and as tough as leather. It will keep out the water. Between the outer covering and the nut is a mass of light loose strings of fiber, that holds the nut in place.

Many of the cocoa-nut trees grow just at the edge of the water and when the nuts with their boat covering, fall into the water, they can float away, and some of them may be thrown by the waves upon the shores of another island. Cocoa-



FIG. 57.—Cocoanut trees in the Islands of the South Seas.

nuts with their coverings on are sometimes brought here as curiosities, and can be seen in museums or once in a while in the market. John says if he ever sees one in a store he is going to get it for his school.

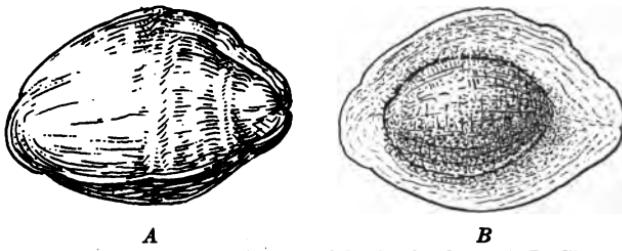


FIG. 58.—A cocoanut. *A*, A nut with the husk on. *B*, Shows the husk cut away to allow the nut to be seen.

NANCY'S SEED CARRYING BIRDS

Nancy told of reading of some of the ways birds carry seeds about. Some plants, like cherry trees, have their seeds covered with a nice fruit that birds like to eat. In the cherry the seed is very hard so that birds cannot harm it. The fruit, when it is ripe, is bright red so that it is easily seen. The fruit is soft and sweet and very good to eat. The birds carry it away to eat, then drop the seed. We may say that the cherry tree hires birds to plant its seeds, and pays them with a nice feast of cherry fruit.

She gave another interesting way by which the birds help the plants. There are many kinds of plants that live in water or just at the edge of streams, ponds or lakes. They have small seeds

that drop down into the mud. Water birds, such as wild ducks, geese or cranes that wade about in such places, get the mud with the small seeds in it stuck fast to their feet. Something may frighten them, and they fly away before they have time to wash their feet. In this way the seeds get carried to other ponds, sometimes a long distance away. It is said that a number of plants are scattered abroad by birds in this way.

TOM'S SQUIRTING CUCUMBER

Tom had learned that a number of plants had seeds which, when ripe, had a sticky substance on



FIG. 59.—The squirting cucumber.

them that would hold fast to the fur of animals or the feathers of birds which touched them and in

this manner get carried away. But the strangest one was a plant called the "squirting cucumber." This is a sort of wild cucumber that grows in some parts of Europe. When it is ripe the inside parts turn into a sticky stuff, which is packed so tightly inside the rind that the cucumber is almost ready to burst. If an animal happens to pass by and touches the ripe cucumber the stem of the cucumber pulls out like a stopper of a bottle. Then the sticky stuff with the seeds shoots out with force and if the animal should be in the way its fur will be spattered with the mess. The poor animal may go a long distance before it has a chance to stop and clean its coat and drop the seeds.

FLOWERS

What would the world be without flowers? We do not like to think of such a thing. In countries where they have cold, snowy winters, the flowers disappear for a few months and the world seems to frown. When spring comes and the cold winds and snow are changed to warm rains and bright sunshine, the wild flowers of the fields and woods lift up their cheery faces and the world seems to smile again.

The children are then just wild to get out and find the first wild flowers that are brave enough to stand up and say old winter has gone and young spring has surely come.

What is the first wild flower to come in the spring? That will depend on what part of the world you live in. In the New England states, the children will find certain ones they know well, which are different from those that the children of Indiana or Kansas find.

In parts of Georgia or California, it would be hard to tell just which flower is the first to come in the spring, because the winter is not severe, so that some flowers may be found blooming at any time. You cannot say just exactly when the winter goes and the spring begins. But even in California, when the spring months come and

the ground is well soaked with water and the air is warmer, the flowers come in greater numbers than at any other time of the year.

In some of the parts of Arizona and New Mexico, where it is very dry most of the year, you might think if you were traveling over the country, that certainly no flowers ever bloomed here. But even here where the few rains of the whole year come in summer, the most beautiful flowers spring up from their hiding places and bloom quickly before the ground goes dry again for many months. Here the children could search for the first flowers of the rainy season, instead of the first flowers of spring.

In the moist, warm countries south of us, nearer the equator, called the tropics, all kinds of flowers, some of them magnificent, bloom the year round. So there are no first flowers of spring but beautiful flowers throughout the year.

Every country has its own kinds of flowers which grow wild in the different places, each in the kind of place it likes best. But people like flowers so much that they can not wait to go out into the fields and woods to gather them. As they wish to have them close by so that they can see them at any time, they plant flower gardens near the house or in parks where the whole city can visit them.

Besides our native flowers, the brightest and most beautiful that can be found in the far away countries are brought to our country to make our flower gardens and parks as beautiful as they can be.

People love flowers so much that every spring they get the flower seed catalogues and send away for seeds and bulbs to plant in their flower beds.

Such great numbers of people want flower seeds and bulbs every year, that large farms are used just on purpose to raise seeds and bulbs to sell to the lovers of flowers.

Every house can have some flowers about it. Many schools have flowers in their yards and in pots in their rooms. I have known of some school rooms where every child had a flower plant of his own to care for and have bloom.

It is very plain why the love of every one for flowers is so great. Their beautiful bright colors enliven field, wood and home so much and the graceful and delicate forms are so pleasant to see and their delicious odors so delightful to smell, that they give us beautiful and pleasant thoughts wherever we meet them. And that is enough to make us love them.

In our love for flowers we do not always stop to think of the real reason why flowers have their bright colors, beautiful forms and delightful perfumes. We might suppose that all these are for our pleasure alone. But when we look more carefully into the life of the plant we find that the flower with all its beauty is formed as it is, first of all, that it may be of the greatest use to the plant itself. Like other beautiful things in Nature, we are free to admire the flower and enjoy it as

much as we like but it does its important work for itself whether we look at it or not. Away in the deep woods where no one ever goes, or high up on the steep, rocky sides of the mountain where no one ever climbs or in the deserts or fields or forests of wild countries which no one has yet explored, flowers have been blooming for thousands of years. But in those unknown regions as well as about our homes the flower is hard at work for the plant that bears it. Now if we can see just how the flower does a work very important for itself it will cause us to admire it more than ever. What is this great work? If we live more closely to the plants and watch carefully just what they are doing they will tell us plainly what their beautiful flowers are doing for them.

THE PARTS OF THE FLOWER WORK TO FORM THE SEEDS

The really most important work of the flower for the plant is in its helping to make the seed. The plant's seeds are surely important enough for the plant, for how could it keep itself going on upon the earth without seeds? It is true that the gardener can keep some kind of plants going from year to year by means of cuttings and bulbs. And many wild plants have bulbs, but most wild plants have no other way of bringing on new plants except by seeds. Even those that have bulbs and other ways of planting themselves, as with runners, need seeds to help them get into

new places. So seeds are very necessary to the plant.

In another chapter we saw that the plants show how great is the care they take of their seeds, while they are growing and also what a number of very clever ways they have in getting the seeds scattered broadcast into new places. Some of these are: the balloons and wings for the wind to use; the burs, hooks and barbs to fasten to the fur of animals; sticky substances for the same purpose; pods that throw the seeds about; boats that float them and many other curious and wonderful ways of caring for the planting of the seeds.

Now when we come to understand a little about the flowers, we find that they have very curious and beautiful contrivances to help them make the seed. That is their great work.

To understand it, we must first know just what part of the flower makes the seeds. The flower has many parts and some of these parts do not turn into seeds, but only help the work along.

As every one knows, there are thousands of kinds of flowers and they are not all alike. They do not all have just the same parts, but great numbers do, although they may be of very many different shapes and colors.

If you look into the face of a flower of a geranium, or of a buttercup, the first thing you notice is the bright colored part—red in the geranium and yellow in the buttercup. This attractive part makes the biggest show. It is called the corolla. The

corolla is the bright smiling face of the whole flower. It is the beauty of the flower. It is this that makes us seek far and wide for the lovely, cheery blossoms to give ourselves and our friends pleasure at the sight of them. If we take the corolla of a buttercup apart, we find it is made up of five pieces each of which is a sort of little yellow leaf. The



FIG. 60.—Parts of a flower; calyx, petals, stamens with pollen grains, pistil. The pistil is represented cut open to show how the pollen grain grows down to join the part that is to become the seed. This part of the flower is drawn as a diagram to show where this growth takes place but it could not be seen in the flower without a microscope and much skill in preparing it.

pieces of the corolla are called petals. In flowers like the morning-glory and petunia, the corolla is not in separate pieces but is all joined into one. It makes a funnel-shaped corolla which ends in a tube at the bottom.

Just outside of the bottom of the corolla is a cup in which the corolla stands. This cup is green and is sometimes made of separate pieces like little

green leaves. But sometimes the pieces are joined together into one. This green cup just outside of the corolla is called the calyx. When the flower is in bud, before it opens, the calyx covers it all over and keeps it safe from harm until the flower opens. These two parts of the flower, the calyx and corolla, do not change into the seed, but they have to do some very important work in getting the seed started.

There are two other parts of the flower which are usually not so showy but are very important in seed making. Just inside the corolla is a row of tiny stalks with knobs on the ends of them. They are numerous in the buttercup and apple blossom, but are few in some flowers like the petunia and geranium. They are called stamens. Out of the little things on the tops of the tiny stems of the stamens, a fine sort of colored dust drops. This flower dust is called pollen. While the particles of dust from the stamens are so very small, yet they are very important in seed making as we shall see.

Now comes the fourth or last part of the flower. That is in the very center of the flower. It is called the pistil. In some flowers there is only one pistil and in some there are a few and in some very many. Of course the pistils, like the other parts of the flower, differ in shape and size in different flowers.

In the flower here pictured which has only one pistil, we see its top standing on a little stalk in the center of the stamens. The bottom of the pistil

is larger than the rest of it. And it is in the bottom part of the pistil that the seed is made. In this part of the pistil is a very small part which can grow into a seed. But before this minute part will start to form a seed there is one thing that must take place.

One of the tiny grains of the flower dust, that is a pollen grain, must touch the minute part inclosed in the thick portion at the bottom of the pistil before that part will start to grow into a seed. There we have the secret of the flower. A pollen grain must join a certain part inside the pistil before there can be a seed. It seems to us impossible that this can be done, but the plant has a fine way to manage it.

In the first place, the pollen grains are alive and if they are planted in just the right place they can grow. Well, the right place is on the top of the stalk of a pistil. The top of this pistil stalk is called the stigma. The stigma is made on purpose to be a good growing place for pollen grains. It is widened out, it is soft and is covered with a sort of sweet syrup. When a pollen grain falls on it, it will begin to grow into a very slender thread, like a mould thread. This thread goes right down through the pistil stalk till it finds the very minute part that can grow into a seed. When the pollen thread reaches this part, then the seed growth begins.

Thus we see that the most important parts of the flower are the stamens with the pollen grains and

the pistil with the beginning seed cell hidden down in its thickest part.

Now, how do the other parts of the flower, the corolla and the calyx, help in this work? It will be very interesting to find out how they make part of the contrivance for getting the pollen grain on the stigma of the pistil, so that the most important thing of all can take place. That is, that the pollen grain shall grow down to touch the important part that is to grow to be the seed.

GETTING THE POLLEN ONTO THE STIGMA

Now if we keep in mind that a pollen grain must be placed on the stigma so that it can grow down to the minute seed cell and start it and the parts around it, growing into the seed and fruit, we are ready to look into the flowers to see how they manage to get it done. Since pollen grains are so very small, just a fine dust in most flowers, and the stigma is quite small too, it looks as if it would be a pretty hard thing for a plant which has no legs or arms and cannot move its parts like an animal, to plant the very tiny pollen grains on the tiny sugary garden of the stigma.

Some plants have flowers whose stamens grow in such a way as to bring the pollen near to the stigma or over it so that the pollen can be pushed up against it or fall on it in some way. This seems to be the easiest way. But it is better for most plants that the stigma of a flower should get its pollen from another flower instead of from its

own stamens. This makes better seeds in very many kinds of plants.

To bring this about, the plants have different ways. In some kinds of flowers the stamens grow in such a way, that the pollen cannot get to the stigma in the same flower.

In very many kinds of flowers the pollen and the stigma do not ripen at the same time in the same flower. That is, when the pollen in a flower is ripe and ready to grow, the stigma in that flower is not ready for it. So if the pollen is to do any good it must be planted on the stigma of another flower, that, like a little seed bed, is all ready for it. In all the plants with such flowers, the plants have to make use of something besides themselves to get this very important work done. That is, getting the pollen from one flower to another.

People who love plants and like to watch their interesting ways, have found out some of the very curious and wonderful means that different plants have of getting this tiny pollen grain carried over from one flower and planted on the little stigma bed of another flower, which may be only a short space away or quite a long distance off.

It is found that the things that plants use for this work are wind, water, and animals. The flowers of many plants are formed for the wind to carry their pollen. Some water plants make use of the water to float their pollen out.

All these are very interesting, but perhaps the most interesting are the ones which make use of

animals to carry their pollen grains around and plant them carefully on the stigmas.

Flowers of this kind are the most beautiful ones and smell the sweetest. The animals that do this work for the plants are mainly: the humming-birds, moths, butterflies, bees, bumble-bees, wasps, flies and many other insects. These flower loving animals, of course, do not know any thing about planting pollen grains on stigmas and they do not care. What they are after is something to eat.

And here is where the wonder comes in; we see how the plants have formed the flowers into most ingenious traps and baited them with sweet nectar or other food, so that when the bird or insect comes to get the nectar, without knowing the good it is doing the plant, it gets pollen of one flower just in the right place on its body to brush it off on the stigma of another flower of the same kind. The plants would die out for lack of seeds if it were not for these humming-birds and insects. The humming-birds and insects would die without the plants. The flowers are formed to fit the insects and the insects are formed to fit the flowers. They both can give us great pleasure in seeing how they are suited to each other, and in watching them work together. The gardens, fields and woods are full of these curious traps and the insects and humming-birds at work in them. Let us find some of them.

A HUMMING-BIRD FLOWER

SCARLET SALVIA

It was Saturday. The children went out into the garden to see how some of their plants were coming on. They soon met the gardener. Bessie told him that they had learned in school that it was necessary for the pollen in the stamens to be placed on the stigmas before the flowers could form the seeds. "That was a good lesson," said the gardener, and he showed them the stamens with the pollen, and the pistils with the stigmas, in several flowers. "The teacher told us," said Bessie, "that the flowers got the birds and insects to help them. That the flowers were traps to make the animals place the pollen on the stigmas. O, how I'd like to see them do it."

The gardener said: "Well, let us hide near that bed of scarlet salvias and watch for what may happen." This bed of salvias was the brightest spot in the garden. The children did not have long to wait before one after another, swiftly whirring, came three beautiful ruby-throated humming-birds. They dashed from flower to flower, hovering an instant long enough to thrust their beaks down the long tubes of the flowers. They darted about so swiftly, that the quick bright eyes

of the children had to be very alert to keep sight of them.

After seeing that the lively little ruby-throat always pushed his long bill down the scarlet tube of the flower, the gardener was ready to show the children just how the flower trapped the humming-

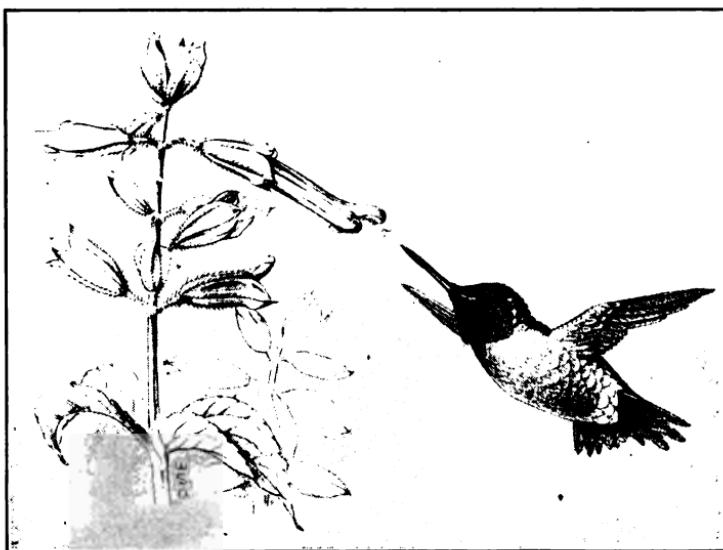


FIG. 61.—A humming bird visiting the scarlet salvia.

bird into doing what must be done that the seeds might form.

Each took an opened flower in his hand to examine it carefully. In the scarlet salvia, sometimes called scarlet sage, both the calyx and corolla are bright scarlet. The corolla is a long tube. The opening of the corolla tube looked somewhat like a mouth, opened ready to swallow something.

Under the upper lip of the mouth, the children found tucked away neatly, and covered up so that the rain could not wet them, the anthers of two stamens and the forked stigma. They were quite well hidden, but their little stems were long and went down in the flower. The stem of the stigma went to the bottom of the flower and the stamen stems went down a short way and were fastened to the sides of the corolla tube.

The gardener then showed them with a thin little stick, that when the humming-bird thrust his long bill down to the bottom of the corolla tube to get the sweet nectar the flower had all ready for it, it made the anthers strike down on his little face. Of course this would dust his face with pollen. Then at the next flower it visited the stigma pressing down on its face would get some pollen rubbed on it. The children were delighted to see the flower actually at work trapping the ruby-throat into doing its work, and not hurting the little fellow a bit, but giving him a sort of ice-cream soda in exchange.

"There is one smart thing," said the gardener "which I think you did not see on this trap." "Look again at the stamens and you will find that there branches off from the side of the thin stamen stem, a little prong that lies up against the corolla tube." The children found this easily enough.

"Now this is a very interesting part of this trap. It is fixed so that the bird, in pushing his bill down into the tube, causes the bill to press against the

prong which acts like a lever, to pry the stamen down on the ruby-throat's face."

"Well," said Tom, "this is surely as much a trap as my figure four that I set for quail. Who would have thought a plant could make such a trap."

The gardener then told them of other salvias

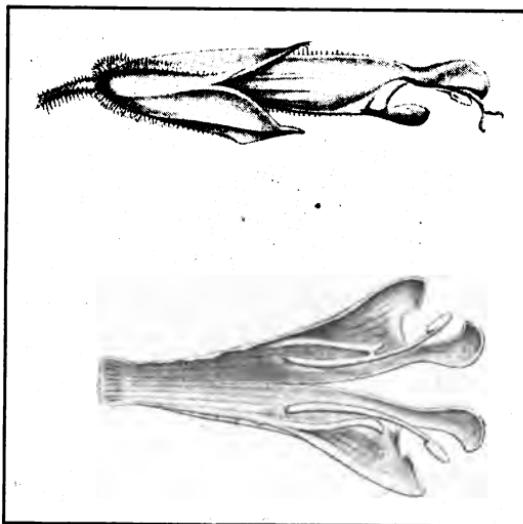


FIG. 62.—The upper picture is the flower of the scarlet salvia. The lower one is of the flower cut open to show how part of the stamen makes the trigger of the trap.

that had flower traps for bumble-bees. Their flowers were shorter and wider mouthed so that a bumble bee could get in. The scarlet salvia seems to like humming-birds better, for its corolla tube is so narrow that a bumble-bee cannot get into it. But in the bumble-bee salvias, the trap is of just the same kind. They have levers on the

stamen stems to trip the anthers on the backs of the bees. The stigma stem does not need a lever, for when the stigma is ready for the pollen its stem grows long and curves down, just to touch the back of the bee. Since the stigma in a flower is not ready at the same time the pollen of that flower is ripe, you see that that stigma must get its pollen from another flower. They say that humming-birds like red, so the scarlet color of this salvia makes its humming-bird trap so much the better. The bright color makes it easy for the ruby-throat to find it.

Now that the children saw that some flowers are real traps, baited and set for some animal and colored so as to be easily found, they were anxious to find out if other kinds of flowers were traps of the same kind.

The gardener who is happy always, to show off his loved flowers to any one interested, gladly promised to lead them in their efforts to catch other beautiful blossoms at their pretty tricks.

BUMBLEBEE FLOWERS

THE SNAPDRAGON

The idea that the blossoms of salvia are traps, stirred the children up to look for other traps among the flowers in the garden. Tom said that he was sure that, from the queer way the flower of the snapdragon is formed, it, too, must be some kind of a trap.

They found a group of these tall plants which were bright with their showy bloom. Tom took off one of the blossoms and showed Bessie how curiously the lower part of the flower pressed tight up against the upper part. If you press the lower part down, then let go of it, it springs up like a mouth shutting with a snap. Bessie thought that perhaps that was why it is called snapdragon. "But how is anything going to get into the flower when it is closed so tightly?" said Bessie.

They found places around the group of plants where they could see well, if any thing visited the blossoms. The gardener watched them but thought he would let them find out about this plant for themselves. They had hardly got seated before sure enough, up came a fine big bumblebee, buzzing in among the blossoms. It alighted on the lower side of one of the flowers. The children



FIG. 63.—The snapdragon.

then saw that that part of the flower had just the shape for a good alighting platform.

The weight of the big bee began to open the flower. Then the bee plunged its head into the opening and crawled right in. In a short time it backed out again, and it was plain to be seen that its back was covered with pollen. This



FIG. 64.—A bumblebee opening the snapdragon. The stamens and stigma will touch its back.

was done so quickly that the children could not see every thing that happened in that first visit. But this bee visited one flower after another and other bumblebees came and went to work in the same way.

This gave the children time and chance enough, with the gardener pointing out a thing or two, to see how the snapdragon made the bee work for it. It gave the bumblebee nectar from a sack at the bottom of the flower. Its anthers and stigma were neatly tucked away in the upper part of the

flower just where the back of the bee would brush against them. Then there was the nice alighting platform. And when the bumblebee started to crawl down after the nectar, the lower part of the flower pressed her up close to anthers and stigma. Soon her back was covered with pollen and as she went from blossom to blossom the stigma would get dusted with it.

The blossoms of the snapdragon were closed so tightly that the rain was kept away from the nectar and the pollen. It also kept many other insects out and held every thing ready for the big bumblebee which was heavy and strong enough to open it.

The bumblebee just suited the snapdragon. If a smaller insect got in, its back could not reach up to the anthers and stigma. It would get the honey but would do the flower no good. Snapdragons and bumblebees are partners and work together.

Of course the children were delighted to have seen for themselves the bee and plant working together. Tom had a chance to say, "I told you that the snapdragon must be some kind of a trap. So now you see how it is. But I must say," he added, "I did not think it could be such a good one."

BUTTER-AND-EGGS

The gardener told them that if they would like to see another flower which was a trap much like the snapdragon, they could look at the plants

called butter-and-eggs, and sometimes toad-flax, growing along the side of the road. They did so and found that they used their traps in much the same way. At the bottom of the blossom of the toad-flax is a spur, in the end of which is the nectar. A bumblebee or a long-tongued honey-bee alights on the flower platform, crawls in and pushes itself in as far as it can to reach the nectar at the end of the spur. This presses the back of the bee up against the anthers containing the pollen and stigmas just as in the snapdragon.

"So that's what the spur in the toad-flax is for, is it?" called out Bessie. "Well, I know of some other flowers that have spurs on them. I wonder if they have them for the same reason." "What flowers?" asked Tom. "Well, there is the columbine for one. And, Oh yes, there is the larkspur for another" replied Bessie. "Why yes, of course" said Tom, "Why didn't I think of them, as they are both in this garden."

THE COLUMBINE AND LARKSPUR

So next these spurred plants had to be watched. A nice group of columbines was close at hand. The columbine blossoms were numerous. Each was made up of five pouches, each pouch ending in a long spur. The anthers with pollen and the stigmas were in a group on a column in the center of the flower. The flower hung with mouth down and the spurs standing up. This kept the rain out.

The children saw their old friends, the bumble-



FIG. 65.—The columbine.

bees come to a flower. A bumblebee would crawl up one of the pouches and stretch her tongue up in the spur for the nectar. In doing this, she would brush her back against the bunch of anthers and stigmas hanging down from the center. By the time all the five pouches had been explored she would have good chances to get plenty of pollen. She of course went from flower to flower carrying the pollen along for the stigmas. The columbine spurs are so long that it makes it a bumblebee flower. Those bees that have shorter tongues can't reach the nectar.

Next the larkspur proved itself to be a bumblebee trap too. It has a good place for the bee to alight on. Then there is a long spur with nectar at the bottom. The anthers and stigmas are placed just where the bumble bee must press against them when she pushes in to stretch her tongue down the spur after the nectar.

The gardener was as much pleased to see the children find out these interesting things about his flowers as the children were to have their eyes opened to the beautiful contrivances they had found, in even the commonest plants.

The gardener said "There is one thing about bees and columbines I must tell you, although there is something of meanness in it." He then explained that there are some bees which do not have long enough tongues to reach the nectar in the spurs, so they get on the outside of the spur and bite into it and suck the nectar out. "Of course when they

do this, there is no nectar left for the faithful old bumblebee and the pollen does not get carried by her to the stigmas."

The gardener took the children back to the group of columbines and sure enough they found some of the spurs with tiny holes bitten into them and bees stealing nectar through them. "That is just what happens to my traps for animals sometimes" said Tom. "I may set it for one kind of animal, and another smaller one, say a mouse, sneaks in and steals the bait without springing the trap."

It was now getting so late that the bees had gone home. Just then the supper bell rang and the children were quite ready with big appetites to enjoy the meal.

Of course they had a lively time telling their mother and father of their experiences. Bessie said, "I am going to write to Nancy about what we have seen and get her and John to see what they can find in their garden." Tom, who is not very fond of writing letters himself was quite willing for Bessie to do this. Later on he said to her, "Next Saturday when we have time let us look for more of the flower traps for insects." Bessie readily agreed to this.

And if it does not rain I am sure we will get some interesting reports from this wide-awake pair.

THE IRIS BLOSSOM

The children had some good stories to tell at school the next day about their finding such

cunning traps in the flowers of their garden. The teacher wished them to bring some of their flower traps, to show the rest of the children. You may well believe that they readily promised to do so.



FIG. 66.—The iris. The stamens and stigma will brush the back of the bumblebee when it tries to reach the nectar.

As it was Friday, they could not do that until Monday. But they were now more than ever anxious to spend Saturday in the garden exploring for a larger number of such flowers.

Saturday morning came with a cloudy sky, which made a cloud of disappointment spread over

their eager faces. But before long the clouds began to break away, and the sun came out and soon the clouds were swept away and the sky was blue and bright. Then the garden shone with color. The birds, bees and butterflies came fluttering and flying and buzzing about. The clouds also disappeared from the children's faces and they went gaily on their delightful excursion.

Having already seen how some blossoms and bumblebees work together, Tom's first thought was to watch for a bumblebee and follow it, to see if any other flowers were fitted to it. Almost at once he saw one with a serious but good natured hum alight on an iris blossom near by. Both children got closer to get a good look at the bumblebee's work. The iris blossom has three parts that turn down, and three that are erect. On each of the parts that turn down is a ridge of soft hairs. The bumblebee alights on one of the turned down parts and crawls along the pathway of hairs to push its head down into the flower and stretch its tongue after the nectar. In doing this it brushes against a stamen with its anther which stands right in front of it, and gets pollen on its back.

Just behind the stamen is a broad piece that looks like a little petal. On its face is a surface which is the stigma. This bends over enough to touch the bumblebee's back. The children did not see the stigma at first. It was so different from the other stigmas they had seen. But when

the gardener showed them which part was the stigma, it was all plain.

Here now was a fine bumblebee trap. The showy erect parts of the blossom were bright flags to call the bumblebee and the rest was a beautifully contrived trap to get him to carry pollen to stigma.

Then the gardener had them see in what way the gladiolus was a fine bumblebee trap. And next they watched bumblebees at work on the foxglove blossoms and found that the blossoms instead of being gloves for fitting on foxes' paws, fit perfectly on bumblebees' bodies and get their pollen planted on the stigmas in return for giving the bees the nectar.

The special form of the pea blossoms is a finely arranged one for bees to get and to carry pollen from plant to plant. The bee alights on the landing place. Its weight presses that part down. The stigma and pollen are thrown up against the under side of the insect. The color and fragrance of the blossom help the bee to find the flower, and then it sips the sweet nectar.

BUTTERFLY FLOWERS

Then there were flowers that had nice little tubes with nectar at the bottom just placed so that butterflies with their long tongues could reach it without trouble. The beautiful visitors alighted and unrolled their tongues which were coiled up like a watch spring under the head. When the butterfly reached its tongue down after

the nectar, it would get pollen on its face. When it visited the next flower this pollen would be brushed upon the stigma of that flower. In some of these flowers the nectar cannot be reached by either the short-tongued or the long-tongued bees. For this reason they must depend on the butterflies with much longer tongues. On this account they are called butterfly flowers.

FLOWERS FOR VARIOUS INSECTS

BUTTERCUPS AND APPLE BLOSSOMS

When the children watched the buttercups they found bees and some kinds of flies visiting the flowers. But they could not see how the flowers were traps. The gardener showed them that at the bottom of each bright yellow petal is a place where the nectar is formed. This is what the insect is after.

In the middle of the blossom is a large number of stamens and just in the center is a number of pistils with their stigmas. When the insect searches for the nectar it crawls around over the stamens and stigmas, and in that way, gets pollen on its body which then can be brushed on the stigmas. So it is as much a trap as is any other flower.

Blossoms of fruits such as apples, pears, peaches and blackberries are formed on something of the same plan. There is a bunch of stamens and pistils in the center over which the bees and other insects must crawl, in order to get the sweet liquid at the bottom of the blossom. Thus they carry pollen to stigmas.

THE SUNFLOWER

The largest flower in the garden was a big sunflower. It was fully a foot across and with its

bright golden fringe of petals, was, as we all know, a very showy blossom. And since it was raised high on a tall stalk, it could be seen from a long distance.

The children determined to find out what kind



FIG. 67.—A sunflower. The large disc is made up of a very large number of small flowers called florets.

of an insect trap it might be. Tom brought a step ladder so that they could see it more closely. Then they found their old friend the bumblebee, crawling over the flower and apparently very busy. It would take a few steps and push its head down

as if it were feeding on something. Then a few steps more and down again would go its head. Its head and body were yellow with pollen.

They could not make out just what was happening. So the gardener said that they could have the big flower and take it apart to find out how it was formed.

When they did so, they were surprised to find that what they had always thought was one big flower, was really a large group of very little flowers crowded together. Each little flower had a corolla in the form of a tube. Inside of the corolla tube were the stamens joined together in a little tube. Inside the stamen tube, was the stigma of the pistil. As the little flower was growing the stamens ripened first and were pushed up by the growing pistil with its stigma.

Later, up came the stigma above the stamen tube and opened out, into a forked top. Now the little flowers over the face of the big sunflower do not all get their growth at the same time. Some are just forming when others are done blooming.

In this way, some have little bunches of pollen on the tops of the stamen tubes and others have the pollen all gone and the forked stigmas standing

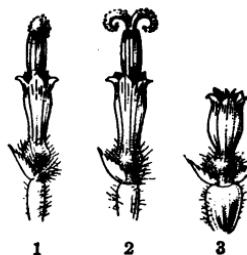


FIG. 68.—Florets from the disc of the sunflower. 1, A floret with the stamen tube and a bunch of pollen at the top. 2, An older floret with the forked stigma growing out of the top. 3, A still older floret which shows the seed at the bottom enlarging.

up above them. The sweet nectar is at the bottom of the tiny corolla tube.

Now comes the bumblebee. It thrusts its tongue down the tube to get the nectar. From some of the little flowers, it gets a load of pollen. On others, only stigmas stand up and the bee dusts them with pollen from its body. So here we have the trap again. Other insects visit this, what might be called a bed of flowers, and help in the same way.

The big yellow petals on the outside rim of the big sunflower, they found to be, each one a very much enlarged petal of a little flower. These, placed on the outside row, make this bed of little flowers look like one big flower. These yellow petals help the sunflower plant by making it easy to be seen and found by the insects.

They saw that this big sunflower was planned just like the dandelion, the dahlia and many other blossoms, all of which are real traps for bees and butterflies.

NANCY'S LETTER ABOUT MOTH FLOWERS AND OTHER MATTERS

Hummingdale, Ohio, June 30, 1921

DEAR BESSIE:

I received your letter about flowers yesterday, and I was just wild to go right into our garden to see if any of our flowers did the same as you tell about the flowers in your garden. I read the letter to John and Mother. John said, "I wonder if it is all true. Let's go right out and find out for ourselves."

Well it was late in the afternoon when I got your letter, and it was about dusk when we reached the garden. It was too late for bees and butterflies to be out and we were disappointed because we would have to wait till next day.

But when we told Mother, she said that there were some blossoms that were just fitted for moths to visit. And moths only came out in the dusk or after dark. She told us that we might go and watch the beds of evening primroses. Then I said, "O yes, I remember now reading about the tomato-worm growing into the big hawk moth which visits evening primroses and other flowers. The story said that it helped the plants form the seeds. But then I did not understand it very well.

But the letter makes it plain. Let's go and watch them and see how it is."

So we went first to the evening primrose bed.



FIG. 69.—Sprig of the evening primrose. One blossom open.

The sun had just gone down but it was still light enough to see quite well. The blossoms here and there were just popping open. I told John it was like a big corn popper only the grains were big and a golden yellow. Soon, sure enough, here came a

whirring something that acted just like a hummingbird. It dashed from blossom to blossom, hovering a short time over each. John declared it was a humming-bird. But one hovered over a blossom so near me that I could plainly see it unroll a long tongue, coiled up under its head. The coil looked just like the garden hose coiled up. It put its tongue down the long tube of the blossom while it still hovered over the flower without alighting on it, just the way a hummingbird does. It certainly was a big moth, and John, when he had a chance to see it quite near, was also convinced.

We then took off a blossom and opened it and found out how it was a moth trap. From your letter we knew what to do. The blossom has a long narrow tube with sweet nectar at the bottom. Right outside, in the flower cup, stand the five stamens and the one stigma. The moth pushes down its tongue after the nectar and jams its head right among the stamens and against the stigma. The pollen it gets from one blossom it carries to the stigma of the next.

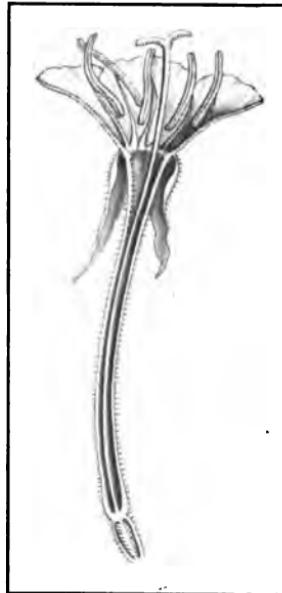


FIG. 70.—Blossom of the evening primrose split open to show how long and narrow is the tube to reach the nectar.

The primrose bed was like a long counter in a country store where the soda water fountain is. The counter was covered with golden glasses with primrose syrup in them. Each customer moth

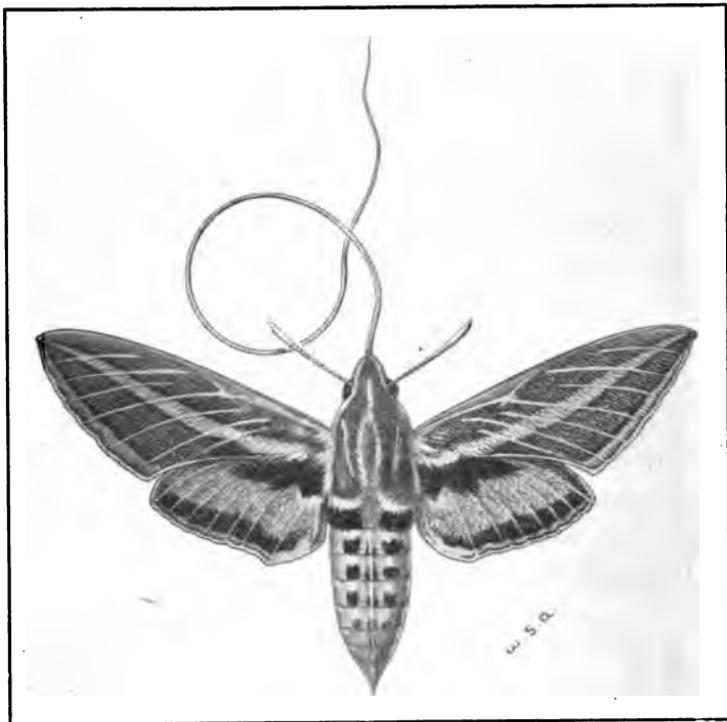


FIG. 71.—White-lined sphinx. One of the moths that visits long tubed flowers.

brought his own straw and had a jolly time. He thought he didn't have to pay any thing. But we know how he paid the plant for his good time.

Mother then had us see how bees and other insects could not get the nectar. And then the

blossoms open best in the evening when moths fly and bees go to bed. She said it was a good moth flower.

We next saw moths visiting narcissus and honey-suckle blossoms. When we examined these flowers we found that they too had tubes with nectar at the bottom and the stamens and the stigma standing out just so that the moth's head would have to push in among them when it tried to get the nectar.

You see if a moth wished some other kind of syrup, he would go over to the narcissus or the honey-suckle counter. He would have a different kind of drinking glass too, but always beautiful.

But it soon grew too dark to see any longer and we had to give it up for that time. Mother told us that there were many kinds of moths that visited flowers of different kinds and helped them get their pollen to the stigmas. As moths fly by night, she told us many of the moth flowers were white and fragrant so the moths could find them after dark.

I often think of the good times we had at your house. And wasn't that seed gathering picnic lots of fun? After learning at that time what bright ways plants have of getting their seeds scattered about, I am not surprised to find them clever enough to grow such good traps to get the insects to carry the pollen about so that the seeds may form.

Now we can hardly wait until tomorrow to see some of the things you wrote about. We have



FIG. 72.—*Narcissus*.

some of the same kind of flowers that you have in your garden and some that you did not tell about.

John wishes you to ask Tom to find out if there are not some water plants around the old swimming hole that need investigation. If so he

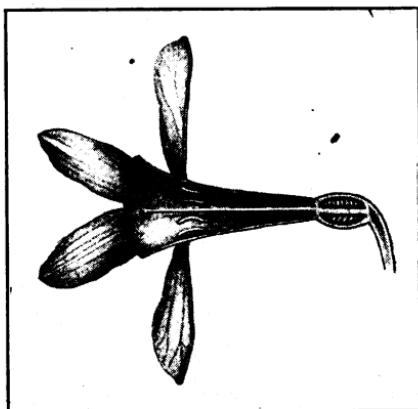


FIG. 73.—*Narcissus*, cut open showing tube to reach nectar.

would like to come down and help him find out about them.

And Oh Bessie, you know those fine, showy, odd looking flowers they have for sale at the flower stores called orchids. Some of them cost a dollar apiece. They say they grow wild in the tropical forests of Brazil and that each one is a curious trap to make insects carry pollen from stamens to stigma. I am going to try to learn about them.

Be sure to write me about any new thing you may find out about flowers and insects. And

Bessie, what are the most exciting things the girls in your school are doing this year? When does your vacation begin? It is your and Tom's turn to visit us this summer.

Goodbye, with love to all, from your friend,
NANCY.

P. S. Mother has just read this letter over and she says you don't have to go to Brazil to find orchids. That we have some in our own woods. Well, when you come up next vacation, we will go out and find them and see what tricks they play on the bumblebees. Talking about tricks, I know a good one we can play on John and Tom. Will tell you when you come.

Goodbye,
NANCY.

A PLANT THIEF

Bessie had started a geranium in a flower pot in the green house. She obtained the slip from a beautiful variety which she saw when visiting her friend at Floraville. It had been growing several weeks and was looking fine. She expected it to bloom soon. As she had not seen it for some days she went to have a look at it.

She was surprised to find a slender yellow thread coiled around the stem of the geranium and sending out branches over the geranium stem and leaves. As the yellow thread had no leaves and had no root in the ground, Bessie thought it did not look much like a plant. She tried to unwind it and take it away from the geranium. But no, it held fast. She found that it had what looked like a lot of suckers that went right into the stem of the geranium and that she would have to tear the bark of the geranium, to get the yellow thread away.

"Ugh! what can the thing be?" exclaimed the little girl. Then she decided to go to the gardener as she always did when she got into trouble about her plants.

The gardener was always quick to help whenever either Bessie or a plant got into trouble. At the first glance he said, "Oh, a Dodder has got into

your geranium pot." "Dodder? what's a Dodder?" asked Bessie. "Well," answered the gardener, "the Dodder is a plant thief, that climbs up on the backs of other plants and picks their pockets. I think, as this is a young one and has not gone



FIG. 74.—A part of a dodder vine with blossoms twining around a plant stem.

very far, we can get it off and save the geranium."

When they had rescued the geranium, Bessie wished to know more about the Dodder. How it could get along without leaves or roots? How did it get started on other plants? Did it have flowers and seeds?

The gardener led Bessie outside of the garden and in a fence corner, showed her a tangled snarl

of Dodder threads growing on some weeds. The slender Dodder vine had numerous clusters of very small flowers. These of course made the seeds which were also small, about the size of clover seeds.

The gardener then explained how the plant lives. When the little seeds ripen they, of course, fall to the ground. They usually do not grow till late in the spring, after most of the other plants have made a good start. When a dodder seed sprouts, it grows out into a small slender thread with a very tiny root sent into the ground. There is just enough food in the seed to take it that far. The tiny thread swings around in the air to find a plant around which to coil. If it never finds a live plant to climb upon, it withers and dies.

If it finds a live plant it twines about it and just where its thread-like stem touches the stem of the other plant, there grow suckers that hold fast and push themselves right into its victim. These suckers draw out the sap, which is the life's blood of the plant, and live on it.

Now, as you know, the green plants get their supplies for food by means of their roots and leaves, but this thief has no further use for either roots or leaves. It grows no leaves and the one little root that it had to start with to help it up to its victim, soon withers away.

For the rest of its life, it lets the plant it is robbing, do the work of food making with its roots and leaves, while it sucks up the rich juices its victim

has made and passes them into its own body.

As it must have seeds of its own to keep its kind going from year to year, it forms an abundance of flowers. "Now would you think such a bad plant could be a near relative to the beautiful morning glories?" added the gardener.

Of course Bessie had an astonishing story to tell Tom. Very excitedly she showed him her rescued geranium, and took him to see the poor weeds loaded down with the robber plants. They learned that there are many kinds of dodders. Some are very destructive to many of the plants that man tries to raise. One infects hop-vines and another hemp plants and other dodders have other favorite victims.

They learned that the bright orange patches which they saw on the salt marshes as they rode to the city, were patches of dodder growing on the marsh plants.

"O, now I remember seeing an advertisement in the paper," said Tom, "which said, "Pure alfalfa seed for sale entirely free from dodder! I did not see what it could mean till now." "Yes," said the gardener, "One of the greatest enemies of alfalfa is a kind of dodder. The dodder seeds look much like the alfalfa seeds and are about the same size. There is great danger that they, when the seed is cleaned, may slip through and get planted with the alfalfa. Then the farmer would be planting a robber with his alfalfa which would soon begin to eat up his valuable crop."

"Well," said Bessie, "so many plants are good and beautiful, I don't like to think that there are any bad ones."

"But I don't know," said Tom, "that what the dodder does is any worse than what we do when we break up a stalk of sugar cane and suck out the juice."

"Well it seems different to me," added Bessie.

PLANTS THAT TRAP ANIMALS

Every one knows how the animals prey upon the plants for their food. The cows and horses take the grasses and grains. The goats strip the bushes of their leaves. The squirrels gather in the nuts. The pigs tear up the ground for the roots and the birds make raids on the fruits and seeds.

Most of the plants appear to be helpless and stand quietly as they are robbed or destroyed for an animal's good. But what would animals and man do without the plants for food?

Plants with green leaves form their own food from the air, water and earth, without disturbing anybody. But animals cannot do that. So they have to wait until the plants make food before they can have any thing to eat. Even those animals which, like the tiger, live on other animals, would have no animals to eat if plants did not live and form food for them.

Man is just as dependent on plants as are the other animals. He does not wait for the plants that grow wild. The gardener plants long rows of cabbages and turnips and the farmer has great fields of corn, wheat and hay. These are gathered in and stored in cellars, warehouses and barns. When all these stores of food are taken from the helpless plants, there is never a thought that they

could put up a fight or do any thing against the animals.

So no one is afraid of a plant. But strange to say, there are a few plants in the world that, beside the food they make from air, water and earth, have learned to like a taste of animal food. They have actually made traps to catch animals for food and thus get even. Luckily for us, these plants only try to catch small animals like insects or even smaller. So we need not be afraid of them.

When watching the flowers, we saw how many of them were cunning traps to make insects do some good for the plants. But the flowers always gave the insects a good dinner in return and let them go without harming them. There are other plants, however, which have traps that hold the insects and kill them, so that the plant can use them as food.

PITCHER-PLANTS

One group of such plants are the pitcher-plants. They are given that name because some of their leaves grow into vessels that are shaped just like pitchers, which will really hold water. But do not think for a moment that these plants are keeping pitchers of delicious water ready for thirsty wanderers out of pure kindness. No, indeed, their pitchers are deadly traps to catch unwary insects and drown them in the water and then use them as food.



FIG. 75.—A pitcher plant from a North Carolina bog.

There are several kinds of pitcher-plants found in different parts of the world. Their pitchers differ in sizes and shapes, but they all trap the insects in about the same way.

Some time ago we were tramping through the lowlands near the coast of North Carolina. On the edge of a pine woods, we came upon a bog. As it was summer the bog was somewhat dried out, so that we could walk about on it. We were surprised to find scattered there, a number of the very pitcher-plants we had been reading about. You may be sure we lost no time in looking into the ways of this insect eating plant.

Each plant had a group of leaves springing up from the ground from a foot to two feet high. They were shaped like tall slender pitchers. At the top of each pitcher, a leaf-like hood stood up more like a flag than a hood. The pitchers were yellow and so slender they perhaps looked more like tin trumpets and for that reason the people called them trumpet plants.

In kneeling down to get a good look, we got what we were not seeking, a very unpleasant smell. The pitchers were a third full of water in which were a number of drowned flies and other insects. The way the flies were caught was this. Each pitcher oozed out sweet nectar around the mouth. The flies coming to feed on the nectar would some of them be sure to slip down the throat of the pitcher. This was fixed so that it was smooth going down. But many stiff sharp hairs grew

in the throat and pointing downward, made it impossible for the insects to crawl up and out. So there was nothing left to do but fall back into the water and be drowned.

Well, what good does such a seemingly cruel trap do the plant? It has been found that the plant sends out into the water, in the pitcher, substances which digest the fleshy parts of the insects just as the stomachs and intestines of animals give out liquids which digest the food they swallow.

So these pitchers are, beside being traps, a sort of stomach by which the pitcher plants supply themselves with animal food, beside the food their roots and leaves form from air, water and soil.

It seems cruel for a plant to offer sweet food and then miserably kill the poor insects because we are not used to seeing plants do such things, but it is not more cruel than what the birds do in catching insects for food, or what some insects do to others, or what man himself does in catching many kinds of animals for food and clothing.

There is another kind of pitcher-plant that is common in the bogs of the Eastern parts of the United States. Its pitchers are wider across and lie partly on the ground. But they are the same sort of traps for insects. They even have a little strip of nectar that reaches from the ground up to the mouth of the pitcher. This lures also crawling insects such as ants which follow up the nectar path until they come to the mouth of the



FIG. 76.—Pitcher plant from Eastern States.

pitcher and fall in. The sharp, stiff hairs on the inside the walls of the pitcher, make it impossible for the victim ever to get out again.

These plants have rather pretty flowers on tall stalks. It looks as if they lifted their faces high, so as not to see the terrible things that go on in the pitchers down below.

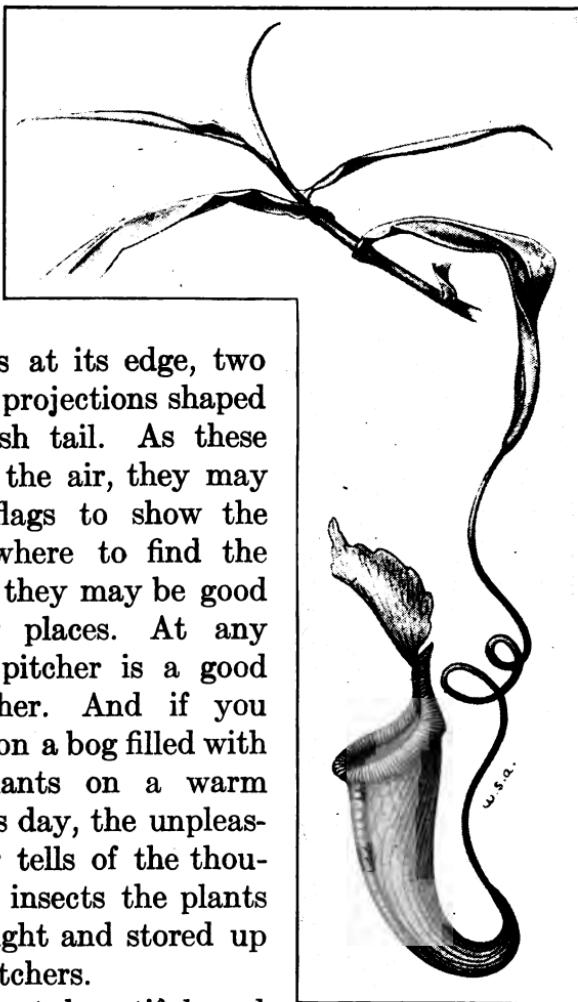
There is another kind of pitcher-plant found in the marshy lands of Florida and Georgia that has a still more cunningly made trap. It has tall, slender pitchers. At the top of each is a good hood that comes pretty close down over the mouth. This leaves only narrow spaces for the insects to get in for the nectar. The most wonderful thing about the hood is, that at the upper part there are many thin places that let the light shine through.

These are like many little window panes. When the poor fly goes to fly out it looks around for an opening. It mistakes the light windows for openings. It dashes against them and down it falls into the water pit ready for it. This pitcher, like that of other pitcher-plants, has its throat lined with spiny hairs pointing down so that the unlucky fly can not crawl up over them.

In boggy places in the Sierra Nevada Mountains of California there grows still another kind of pitcher-plant. It is much like the last one mentioned. It has a hood fitting close. The hood has the window-like places. The pitcher has water and stiff hairs in it. In this pitcher-plant the



FIG. 77.—Pitcher plant from mountains in California.



hood has at its edge, two leaf like projections shaped like a fish tail. As these wave in the air, they may act as flags to show the insects where to find the plant or they may be good alighting places. At any rate its pitcher is a good fly catcher. And if you come upon a bog filled with these plants on a warm summer's day, the unpleasant odor tells of the thousands of insects the plants have caught and stored up in the pitchers.

The most beautiful and the most gracefully shaped plant-pitchers, are the ones named *Nepenthes*. They do not grow in our country, but are found in tropical countries. Sometimes they are to

FIG. 78.—*Nepenthes*.

be seen in the greenhouses in the public parks. There are a number of kinds of this form of pitcher-plant.

One is almost a vine whose leaves are tipped with the pitchers. The leaves of the plant are long and large and hang down, but each ends in a long, slender, stem-like part which droops down for quite a distance, and then gracefully bends upward and bears a beautifully shaped pitcher with a very pretty lid held up over the mouth.

These pretty pitchers started the name pitcher-plant. We use the name for those too, which are not shaped as gracefully and perfectly as our pitchers.

All kinds of pitcher-plants act in the same way. They trap insects and digest them as food which is taken into the plant sap. In some kinds, where the covers of the pitchers are not complete, some rain water can get in. Those with good hoods or covers keep the rain out and furnish all the liquid found in the pitchers from the plant's body. In that way they are just like stomachs of animals.

But even in those forms where some rain water can get in, the plants furnish part of the liquid which has power to digest the fleshy parts of animals.

THE SUNDEW

It was interesting to learn that the pitcher plants set curiously planned traps to catch insects and kill them for food. Still there are plants that go further than the pitcher-plants. Besides

setting traps they actually make movements to catch and hold the poor insects until they are devoured. This seems hard to believe if you



FIG. 79.—Round-leaved sundew.

have not seen them at work. But such plants are common in some parts of the world. Anybody living in those countries can see them whenever they wish.

One group of such plants is called the Sundews. Another name for them is Drosera. There are many kinds. One of the most common which is found in this country and in European countries is called the round-leaved sundew. It is a pretty little plant, growing in bogs or marshy places. It has a nodding group of white flowers on a slender stalk a few inches high. At the bottom of the stalk right next to the ground, is a cluster of round leaves, each about half an inch across. These little leaves are among the most curious things in the plant world. The upper surface of each leaf is covered with about two hundred minute stalks each ending in a little knob. Indeed we might say that the leaf was like a small pin cushion, stuck full of pins. Out of the head of each pin there oozes a clear liquid, which covers it like a bright drop of dew. When the sun shines on the leaves the drops sparkle and make a pretty object. This gives the name sundew to the plant.

But, poor little fly, beware! If you think this shimmering dew is sweet nectar for a morning breakfast and fly quickly to get a refreshing drink, you are deceived. You might just as well have flown right into a spider's web. When a fly alights on the deceitful dewdrops its feet stick fast. When it tries to pull out its legs, they get in deeper. As it struggles, it soon gets its body, and wings too, covered with this sticky mass.

And now more terrible still, the pins of the pin cushion begin to move. The heads bend toward

the fly, first those nearest it and then those farther away, until they all close down on it and hold it fast until it is killed. The little pins are very much alive. They act just like the tentacles of some animals.

When the fly dies, it is still held by these little pins and more liquid is poured out around it. This liquid has substances in it which like the liquids in our stomachs and intestines, can digest flesh. So the fly is held till its flesh is all digested and taken into the plant as food. Nothing is left but the hard parts of the fly's body, legs and wings. This may take a few days. The dry remains of the dead and digested fly are then blown away by the wind. The pins rise up again and the bright dew-like drops come out on the pin heads and the innocent looking leaf is ready for another unsuspecting insect.

The largest number of insects caught by the sundew is of the small kinds of flies, gnats and midges, but it has been known to catch and devour as large an insect as a small dragon fly. Now, as the long body of such an insect can not be covered by one leaf, other leaves come to the help of this leaf and, working together, they manage to hold the insect and digest it. Such action by a plant is so very unusual that it is but little short of marvelous. Even by scientific students it is considered one of the most wonderful things that any plant does.

As we have already pointed out, there are very many kinds of Sundews or Droseras. They differ

in the size and shapes of the leaves and in their flowers. They are found in most parts of the world. They are all alike in this wonderful way of catching and digesting insects.

VENUS FLYTRAP

The most wonderful of all the insect eating plants is the Venus Flytrap. Another name is *Dionaea*. Its leaves have movements quick enough to catch a fly. Its trap is strong enough to hold the poor animal until it is digested. Its trap is as artfully planned and is as surely a trap as is the best steel trap for catching rats or minks. When it first became known that it caught insects and ate them, it astonished botanists as well as other people to find that a plant was able to do such marvelous things.

The Venus Flytrap is a very prettily little plant found only in bogs in the eastern parts of North Carolina and farther south as far as Florida. Its flowers are a group of white blossoms on a stalk a half a foot high. At the ground the flower stalk is surrounded by a cluster of leaves, each carrying on its end a remarkable insect trap. A single leaf is one or two inches in length. Its stem is broad and green. At the end are two rounded parts opposite one another.

The outer edges of these are armed with a row of spikes. On the middle of each rounded part are three slender stiff hairs. The three little hairs are the triggers, the spines at the edges are the teeth



FIG. 80.—Venus flytrap.

of the trap. When the two halves of the trap lie open, it is all set for its victim.

Now let an unlucky fly alight on the trap in a way to touch one of the tiny hair triggers, and before it knows what has happened the two sides spring together, and the spike teeth cross each other and the poor fly is held in a strong death grip.

A liquid comes out of the surface of the leaf that digests the soft parts of the fly. It may take a few days to digest the fly, but the trap holds the body fast all the time till it is finished. Then the trap opens, and the liquid stops coming out of the leaf. The digested part has been taken up by the leaf. The dried remains of the fly's body can drop out now, or be blown away by the wind. The trap is set for another victim.

Flies are not the only insects caught by this treacherous plant. Many kinds come into its traps. Sometimes a tiny insect can crawl out between the teeth, or an insect may be too large to be covered by the trap and may manage to break away. But great numbers of those that are caught cannot get out of this cruel grip and die a slow death in its jaws.

Although the little trigger hairs will start the trap closing if touched ever so lightly by something solid, like a thread or a fly's leg, the beating of rain drops or the rush of the wind will not make them start the action of the trap.

A very strange thing too, about this trap is,

that if you touch the triggers with something that has no digestible food about it, like a bit of thread, or paper or cork, it will close the trap but will not hold it long. But if the thing caught has nourishing food in it, like an insect or even a bit of meat or cheese it will hold it till it is digested even if it takes several days.

It is certainly a strange thing that a plant leaf can tell in some way the difference between things that are meat food and things that are not. In this it is like the sundew. The thing that makes the Venus Flytrap more wonderful than the wonderful sundews, is that it has the strangely delicate or touchy hair triggers that bring about the quick clasping of the jaws of the trap.

Of course none of these are more wonderful than the movements that we see animals do every day. But we are used to that in animals, and besides we know that they have brains, nerves, muscles and bones. And we can see something of how they work. But to see a little plant which does not have brain, nerves and muscles like ours, do such things is enough to make even the greatest of scientists wonder.

THE CAMPUS SICKLE-BILL

BIRD LIFE ON THE STANFORD CAMPUS

Every year a larger number of birds go to school on the Campus than there are students who go to the University for their education. The studies the young birds take are quite different from those the students take in the University but they are very important for the birds, just as important for them as are the studies of the University for the students. What the birds learn is so important for them that if they did not learn it well they could not get along at all.

They learn to fly among the first things. If they did not learn that well, the cats, dogs, rats, skunks, weasles, minks, coons, foxes, wild cats and coyotes and many others of their terrible enemies would soon catch them and make an end of them. Then each kind of bird must learn what kind of food is best for it and where to find it and how to get it. Some live on seeds of different kinds. Some on fruits such as cherries and berries of many kinds, which they must learn to find when they are ripe. Others live on insects or worms. These are of very many kinds which know how to fly, or run or crawl away and hide from the birds, so that birds have to learn where to look for them

and how to catch them, and if each bird does not know his lesson on foods well, he will surely starve.

Then, further, the birds have to learn how to build nests. Each kind of a bird builds the kind of nest that best suits it. There are then many kinds of nests and some of them are very hard to make, and each bird has only one stiff little bill with which to make its nest. I do not see how it can do it but in some way it learns how to perform the difficult task.

Then they must learn to care for their eggs and hatch out the little birds, then feed and care for them till they are grown. Then they must teach the young birds to fly and hunt for their own food.

Besides all this the birds learn to call to each other. They learn a bird language. And they also learn to sing.

Now all this is their education and each one must get it to live a bird's life. It makes them a busy lot of people. They get up early in the morning and hurry around all day. It is quite a bit of fun to watch them. They are certainly as busy in the campus trees and bushes as the students are in the University buildings.

There are a great many kinds of birds which make their homes on the campus and all are very interesting. Each kind has its own bird language and many have some kind of song. Some of the songs are rather short but the best singer among them all is the Sickle-bill and it is about this nice bird that I wish to tell you at this time.

THE SICKLE-BILL

It is sometimes called the California Thrasher. There is a bird in the Eastern States much like this bird which is named the Brown Thrasher which is also a fine singer. So they call our bird the California Thrasher. Most children call him Sickle-bill because his bill is curved something like a sickle. He is certainly a fine singer. There is one which lives in the park next to the Art Gallery. Almost every day between one or two o'clock I go down to hear him sing. I am almost sure to find him perched in the very top of one of the monkey-puzzle trees or young redwood trees, the highest place he can find.

There he sings a most charming song. It is longer than the song of any bird around here. Sometimes the song is kept up as much as half an hour. Then down he drops among the bushes where he runs about hunting for his dinner. In a little while he is on the top of another tree pouring forth another song. If you wait for him he may give you several songs in one afternoon from different trees. Sickle-bills generally choose for their home a place where there are many low bushes. They are very shy birds, hiding most of the time in the bushes where they live. They run along the ground quickly from one bush to another.

I love to watch this sickle-bill singing. His food is the insects and worms which he finds in the ground under the bushes. Here is where his big



FIG. 81.—The California thrasher. The sickle-bill.

sickle-shaped bill is useful. He digs up the leaves and soil with it. He can surely make the dirt fly. He uses his bill as a pick or hoe. He strikes it into the dirt and jerks it toward himself. As he does this rapidly the dirt and leaves scatter behind him in a lively manner. Then he looks over the dug up ground to pick up what insects or worms he has uncovered. He then jumps to a new spot and is at it again. But at the least sign of danger up he slips into a bush, hiding till he thinks the danger is past. Then he hops down again and runs from bush to bush and gets busy at his digging.

I don't see how a hawk could ever catch a sickle-bill for he keeps himself so much out of sight and is so quick to hide away. The only time he is to be seen very well is when he is in the top of a tree singing and then at the first hint of danger down he drops through the limbs of the tree out of sight and harm.

FEEDING THE SICKLE-BILL

The sickle-bill which lives in the park by the art gallery, which Alice and I have named Bird Park, has become tame enough to let us feed him. Sometimes we visit this Park to watch him. We get under a tree and sit quietly with our bread or cake crumbs ready. Soon we see him peeping out under one of the bushes. I throw some bread crumbs toward him and he comes running toward us to get the crumbs, coming very close to us, but just out of our reach. Then we get a good

look at him. He picks up a crumb and if it is small enough he swallows it but if it is too big he runs off with it and then beats it to pieces small enough and soon comes back for another piece.

Some other birds come around for their share. If they are small sparrows he may drive them away. But once there came a jay-bird plunging down among the crumbs and grabbed the biggest piece, just like a jay, and shot off with it like a blue streak. Sickle-bill doesn't seem to like a jay and is a little afraid of him. After he ate several crumbs he slipped away and soon we heard him singing, perched on the top of a monkey-puzzle tree. After a good long fine song he came down for some more crumbs.

One day he came three times for crumbs and gave me three songs from different treetops. At one time when a shower of rain came up he sang right through it. This time he sang twenty-eight minutes. I timed him by my watch. Usually his song is loud and clear but sometimes he sings it very softly as if he were humming it over to himself.

The old gardener who takes care of this park also feeds the sickle-bill and they are good friends. Sometimes a thoughtless student will walk right over the gardener's nice raked beds leaving great holes in them with his feet. This makes the old gardener greatly provoked, but when the sickle-bill pours out one of his fine songs it makes the gar-

dener feel better. The gardener calls the bird Bill and it will come for food at his call.

RELATIVES OF THE CALIFORNIA THRASHER

There are several other kinds of thrashers with sickle-bills, in parts of California and nearby States. They all have beautiful songs and are as interesting birds as our Sickle-bill. Children in this part of the country will be delighted to make the acquaintance of the one that lives near them. Those who live in the Eastern States may find as charming a friend in the Brown Thrasher which makes its home with them.

That you may compare our favorite with the one you know I will tell you of his looks and give you his picture. He is a pretty good sized bird about as large as our jay-bird. He has a strong, long bill curved like a sickle. The tail is long and he holds it up well when he runs along the ground. He is a fast runner. His clothes are very modest in color; a sort of slate or gray color. The throat is light in color and on each side of his head and neck behind the eye are dark lines. The feathers on the under side just beneath the root of the tail are reddish brown. While he is a very neat-looking bird he is not at all showy. But he makes up for any lack of show in feathers by the beauty of his song. Sickle-bills or California Thrashers are sort of cousins to the mocking-birds which are common in the southern part of California. The mocking-birds are fine singers too and are very

interesting because they can sing other bird's songs as well as their own. Once in a great while a mocking-bird visits the campus. But the dear old Sickle-bills stay with us all the year. He is one of our best and most constant friends.

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